Industrial QUALITY CONTROL

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In This Issue

Using Edge-Notched Cards in ANOVA

Applying Attribute Sampling to Non-Randomly Distributed Defects

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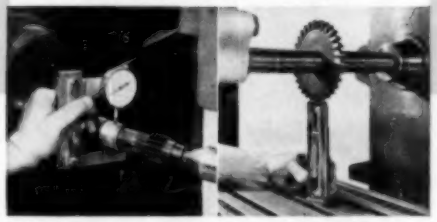

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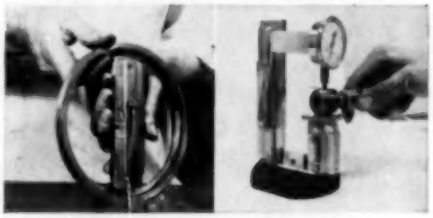

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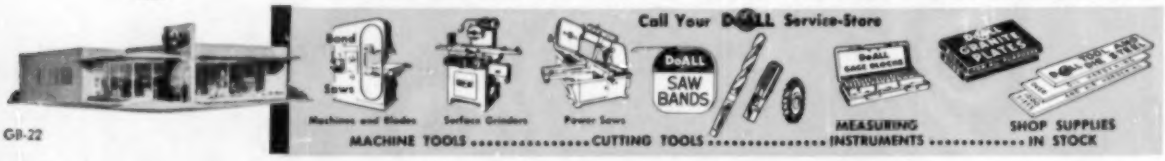

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Contents

ARTICLES

Use of Edge-Notched Cards in the Analysis of Variance
Lloyd S. Nelson 5

Attribute Sampling When Defects Are Not Randomly Distributed
Irving W. Burr, Frank G. Norris, John W. W. Sullivan . 8

Some Remarks on the Problem of Tolerance Limits
Bernard Ostle 11

DEPARTMENTS

From the President's Desk, *Program and Speaker Activity* . . 4
Supervisor's Circle 14
Problems Department 16
Book Reviews 18
Eleventh Annual Convention
Committee Meetings Schedule 19
Program 20-21
Registration Form 22
Exhibit Descriptions 23
American Society News 26
What's New? 27
Local Section News 31
IQC Advertisers Index 36
Bibliography 39
Positions Available 32, 40
Consulting Ads 40

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From the President's Desk

Program and Speaker Activity

There is a growing number of requests from Sections for recommendations and scheduling of speakers. Recognizing that monthly meetings are the heart of most Section programs, it is my pleasure to describe, briefly, three ways in which your Society is now organized to assist Sections in obtaining speakers.

Firstly, the Program and Speakers' Committee has been publishing revised editions of an ASQC Speaker's List for several years. Contained therein are the names of some 300 speakers who have indicated a willingness to participate in a general speaker's program for the Society. The list includes suggested topics as well as an indication of the extent to which companies are willing to underwrite travel expenses of the speaker. This list is readily available to Sections simply by having the Program Chairman address a request to Henry Jacobson, P. R. Mallory Company, Indianapolis, Ind.

A second plan on Speaker Programming was begun a year ago on a exploratory basis. At the time, three members of Fellow status were invited to be ASQC Lecturers on a Series basis. The Series was conceived with the idea of making a few distinguished Society speakers available to inviting Sections—especially those Sections having difficulty in obtaining speakers because of distance and travel time involved. The problem usually was that of obtaining the services of a good speaker who was in a position to travel a long distance with just a single speech as justification. If there could be a series of 3 or 4 talks on successive nights at Sections in adjacent areas, the justification could be made easier. An arrangement of this nature was made for some rather distant areas in the United States with the following speakers appearing in the areas noted:

1956-57 ASQC Lecture Series	**Sections Visited**
Simon Collier, Past President, Fellow ASQC and many others, Director of Quality Control, Johns-Manville Corporation.	Portland Seattle San Bernardino
A. V. Feigenbaum, Fellow ASQC, Author of *Quality Control, Principles, Practice and Administration*, Director of Cost and Quality Control, General Electric Company.	San Bernardino Los Angeles San Francisco Kansas City
Paul S. Olmstead, Fellow and Executive Director ASQC, SQC Consultant, Bell Telephone Laboratories, Inc.	Dallas Houston Waco Denver

Tentative arrangements for a limited number of 1957-58 ASQC Lecture Series are being planned by Chairman Paul K. Leatherman of the St. Louis Section. Paul with his wealth of experience as Chairman of the Eighth ASQC Convention and as past Executive Director is highly qualified to aid Sections in this phase of our Speakers' program. Requests for consideration in the 1957-58 planning should be addressed to Dr. Paul K. Leatherman, 6052 Pernod Avenue, St. Louis 9, Mo.

Thirdly, your Section Program Chairman is invited to contact the Chairman, or any members, of the Program and Speakers' Committee to obtain information about available speakers and the topics they cover. You understand, of course, that this is not intended to limit you in your privilege of contacting directly any speaker of your choice. The members of this committee are Leonard A. Seder, Fred C. Schulze, Paul Olmstead, Henry Jacobson, William MacCrehan, Jr., Edwin C. Harrington, William E. Gaunt, David Chambers, Allan Haskell, Ellis Ott, Henry Becker, Edward J. DeLate, A. V. Feigenbaum, Paul K. Leatherman, and Charles A. Bicking, Chairman.

The three methods described may be a means of helping you to schedule new names, new faces, and new ideas for your Section programs. We trust you will make the most of the services available. In this connection we should also like to acknowledge publicly the unselfish contribution being made by so many of our talented members—often at substantial personal sacrifice—in the interest of seeing our Society move forward.

Sincerely,

Dale L. Lobsinger

Use of Edge-Notched Cards in the Analysis of Variance

LLOYD S. NELSON*

General Electric Research Laboratory, Schenectady, N. Y.

The general technique for analyzing factorial experiments consisting of several factors at various levels is that of compressing the data into 2-, 3-,. . ., n-way tables, analyzing the variance of these individual tables, and combining the results in a master table. When each factor is at only two levels, this technique is no longer the most efficient; the required mean squares can be derived directly from the average change in response produced by going from one level of a factor to the other.[1,2]

If factor A (at levels A_1 and A_2) of a 2^n factorial experiment is considered, then

$$\text{Mean Square for A} = \frac{(\Sigma\ A_1 - \Sigma\ A_2)^2}{2^n} \quad (1)$$

Equation (1) says that to get the mean square for factor A, all that is required is to sum the responses for all runs done with A at the lower level and subtract from this the sum of the responses for all runs done with A at the upper level. The difference obtained is squared and divided by the total number of runs made. As will be seen later, the same argument also holds for determining interactions of all orders.

For this analysis, each item of the data is assigned a positive or negative sign depending on which mean square is to be calculated.[3] Under this condition, the analysis can be mechanized by the use of edge-notched, hand-sorted cards. The general utility of these cards has been fully treated.[4,5] Yates[6] developed a method of analyzing 2^n factorial experiments which, by a series of summing and differencing operations, produces values given by the square root of the numerator of equation (1). Although Yates' method is economical of operations, it requires that scrupulous attention be paid to the many possible changes in algebraic sign. Also, since the calculations must be carried out in a certain order, all of the factors and their interactions usually have to be calculated before any of them can be assessed.

The method of analysis described here is operationally extremely simple and easily taught to statistically untrained personnel. In addition, since the calculations are not necessarily carried out in any special order, the error term of the experiment can be calculated first. This advantage, and others, will be discussed later.

To illustrate this method, the construction of a deck of cards for the analysis of a 2^3 experiment (i.e., three factors each at two levels) will be described in detail. The layout for such an experiment is given in Table I. In each of the cells is a symbol which uniquely describes the treatment associated with that cell. The notation[6] indicates by the presence of a lower-case letter the upper level of the factor associated with that letter, and by the absence of a lower-case letter the lower level of this factor. The symbol (1) indicates all factors at their lower levels.

The deck will consist of eight cards each of which will be marked with a different one of the symbols appearing in the cells of the design in Table I. The average change in response or effect of factor A is, in the notation of Table I,

$$A = \tfrac{1}{4}\,[a + ab + ac + abc - (1) - b - c - bc]$$

and similarly for B and C.

The effects of two-factor interactions are set up as follows. For the AB interaction the average response at A_1B_2 and A_2B_1 is compared with the average response at A_1B_1 and A_2B_2. That is

$$AB = \tfrac{1}{4}\,[(1) + c + ab + abc - b - bc - a - ac].$$

The general rule can now be given which will enable any effect to be set up in terms of the notation illustrated by Table I.

1. To determine main effects, those symbols in the lower-case notation which contain the letter of the factor in question are given plus signs. Those symbols which do not contain the letter of the factor in question are given minus signs. The algebraic sum of the values associated with these lower-case symbols is then divided by one-half the total number of runs to give the effect.

2. To determine interaction effects, those symbols in the lower-case notation which contain either none or an even number of the letters corresponding to the interaction in question are given plus signs. Those symbols which contain an odd number of the letters corresponding to the interaction in question are given minus signs. The algebraic sum of the values associated with these lower-case symbols is then divided by one-half the total number of runs to give the effect.

According to this general rule, the expression for the effect of the three-factor interaction ABC of the design in Table I is

$$ABC = \tfrac{1}{4}\,[(1) + ab + ac + bc - a - b - c - abc].$$

Returning now to the deck of edge-notched cards, hole number 1 will be designated to represent factor A. The deck is divided into halves such that the cards bearing the symbols (1), b, c, and bc are in one half and a, ab, ac, and abc are in the other half. Now, if hole

TABLE I—Layout of 2^3 Factorial Experiment

	A_1		A_2	
	B_1	B_2	B_1	B_2
C_1	(1)	b	a	ab
C_2	c	bc	ac	abc

*Dr. Nelson is presently with the Advanced Lamp Development Laboratory, General Electric Co., Cleveland, Ohio.

number 1 is notched for the cards marked (1), b, c, and bc, the deck can be split into these two halves regardless of the order of the cards. It does not matter which half of the deck is notched. When individual experimental results are entered on the cards in accord with their notation, the comparison of A_1 with A_2 is quickly accomplished.

Holes numbered 2 and 3 are assigned to factors B and C, respectively. For B, number 2 holes on cards ab, bc, b, and abc can be notched. For C, number 3 holes on cards ac, bc, c and abc are notched.

Interactions AB, AC, and BC are represented by holes 4, 5, and 6. For example, hole number 4, corresponding to interaction AB, is notched on cards (1), c, ab, and abc. Of course, the other four cards, a, ac, b, and bc could be notched instead. Again, it makes no difference which half of the deck is notched.

The last interaction, ABC, is assigned hole number 7, and cards (1), ab, ac, and bc (or the complementary set) have their hole number 7 notched. The deck is now complete and ready for use.

Individual experimental data recorded in Table I are transferred to the appropriate cards. The mean square for factor A is obtained by inserting a rod through hole number 1 and splitting the deck into two halves. The values in each half are summed and the difference between these sums is squared and divided by the total number of runs, here eight. The operations required by equation (1) are now complete. All other mean squares are obtained similarly. It is apparent that by the use of edge-notched cards, the mean square of any interaction is as easily calculated as the mean square of a main effect.

Figure 1 shows a deck of eight cards corresponding to the experimental design in Table I. Of course, it would be impractical to analyse such a small experiment by this technique. However, this example makes it possible to show the position and identity of every card.

Holes 1 through 7 correspond to effects A, B, C, AB, AC, BC, and ABC, respectively. Interaction AB is shown being determined by dividing the deck in two at hole number 4. For illustrative purpose experimental data (percent yields) have been entered on the cards. When data for new experiments are entered on the cards, the data already present is crossed out.

Two checks exist for this technique. First, if the sums are obtained on a calculator, the smaller sum is first added to the larger sum and then subtracted twice. The sum of the two sums is a constant (i.e., the grand total of the data); the second operation produces the required difference. Second, in factorial experiments where each factor is at two levels, the sum of all the mean squares must equal the total variation (i.e., total sums of squares) of the data which is easily calculated independently by the formula

Total sums of squares

$$= \Sigma\, x^2 - \frac{(\Sigma\, x)^2}{N}$$

where x = each individual value and N = total number of runs.

Now that the theory behind the notching of the cards has been outlined, a very efficient system for making a deck can be described. When the holes for the main factors have been notched (after hand sorting into appropriate halves), the halves for the two-factor interactions can be generated in the following manner. The rod is pushed through hole number one (factor A) to separate the deck into halves. Now the rod is inserted through hole number 2 (factor B) in each of these two piles, dividing each pile into halves and making a total of four piles. These four piles are combined into two piles in such a way that the lower case letters a and b occur together or not at all in the symbols on the cards in one pile, and only one of these letters occurs in the symbols on the cards in the other pile. The hole assigned to interaction AB is notched for one pile or the other.

After the two-factor interactions have been generated from the main factors, three-factor interactions can be generated from the main factors and the two-factor interactions, and so on. Reference is made to General Rule No. 2 described previously.

A deck of sixty-four cards for analyzing 2^6 factorial experiments has proved extremely useful for the analysis of about 50 factorial and fractional factorial experiments over the past two years. This deck was notched to make possible the calculation of the six main effects and all their two- and three-factor interactions. Notching for one four-factor interaction, viz., ABCD, was included to complete the 2^4 factorial. It was felt that, although only about two-thirds of the available holes were used, the calculation of mean squares for interactions other than those mentioned would seldom be required. The only limitation, however, on how many effects can be accommodated is the number of holes available on the particular style card used.

A deck such as that just described can also be used for the analysis of experiments smaller than 2^6. In order not to have to handle the whole deck when a smaller experiment is to be analysed, it has been found convenient to select an extra hole, label it "24" and notch this hole on all those cards not needed in the

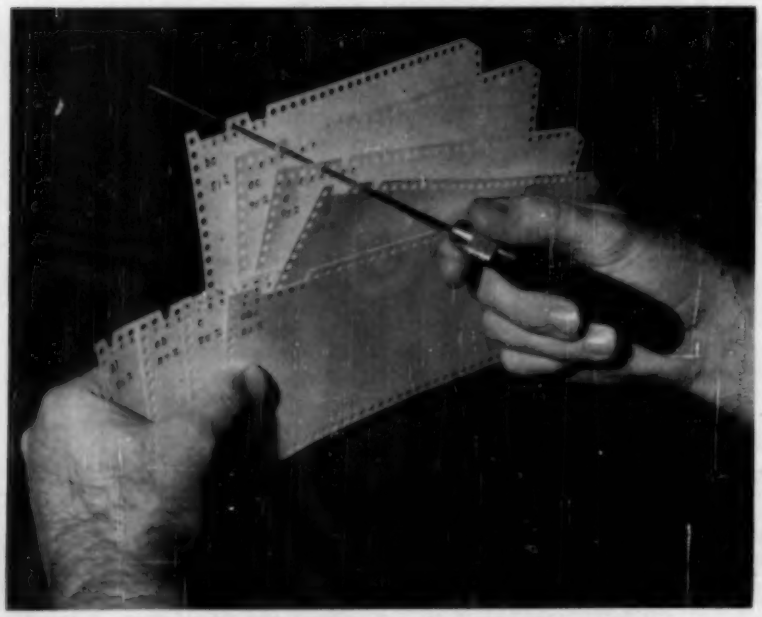

Figure 1—Deck of Cards Corresponding to Design in Table I. Interaction AB is Shown Being Determined

analysis of the 2^4 factorial experiment. This permits the sixteen required cards to be lifted out and used separately.

For a 2^5 factorial experiment the required cards can be separated by dividing the deck in half at hole 6 (corresponding to F, the sixth factor). Two half replicates of a 2^6 factorial experiment can be obtained by dividing the deck in half at whatever interaction corresponds to the defining contrast (most commonly the ABCDEF interaction). Since the notching of this particular deck was not carried past the first four-factor interaction, an extra hole was used to enable the half replicate of a 2^6 factorial experiment to be separated.

For a permanent record of the results, mimeographed sheets containing columns headed Item, Hole, Sum_1, Sum_2, $(Difference)^2/N$, F-Ratio, and Significance are used. The card holes and corresponding items (i.e., factors and interactions) are listed on the sheets as is shown in Fig. 2. If the mean squares for any interactions other than those listed are required they can be easily generated in two operations by the procedure used to construct the deck and summarized on a separate sheet. It has been found useful to have two F-Ratio columns and two Significance columns for possible use with different residuals which might be formed.

In addition to providing a simple analytical technique which requires no statistical knowledge to master, this method presents several additional features. The mean squares of the components of the error term can be calculated first. With the use of the relationship shown in equation (2), it is then possible to check the significance of all effects (in a Model I analysis of variance of a 2^n factorial experiment) without having to carry the calculation beyond collecting sums. The mean square for error is used in the following equation to give a critical sum for use in assessing the sums in columns three and four of Fig. 2.

$$C_\alpha = \tfrac{1}{2}\left(\sqrt{ENF_\alpha} + \Sigma x\right) \qquad (2)$$

where

C_α = critical sum for the α significance level
E = error mean square
N = total number of runs
F_α = critical F ratio for α significance level with 1/error degrees of freedom
Σx = grand total of the data

For convenience only the positive root in equation (2) is taken and all sums are checked against the critical one. Those sums exceeding the critical sum are judged to be significant. Usually the two critical sums $C_{0.05}$ and $C_{0.01}$, representing the five percent and one percent significance levels, would be calculated and used to assess the sums otherwise required for equation (1). No mean squares beyond the error mean square need be calculated.

Although this analysis by means of critical sums applies only to factorial experiments having all factors at two levels, any factorial experiment in which the number of levels of the factors can be expressed as integral powers of two can be analyzed by the computation exemplified by equation (1). For example, the analysis of a 4×2^3 factorial experiment can be carried out by dividing the four-level factor into two two-level factors. Let factor X be the four-level factor and factors C, D, and E be at two levels each. Factor X is then represented by two (pseudo) two-level factors which will be called factors A and B. The results are then calculated using edge-notched cards just as though the experiment were a 2^5 factorial. The mean square for factor X will be the sum of the mean squares for A, B, and AB. Similarly, the mean square for the interaction XC will be the sum of the mean squares for the terms AC, BC, and ABC. Other interactions can be obtained by this same procedure of summing those mean squares of terms containing A, B, and AB to obtain the mean squares for combinations containing factor X.

The technique of using edge-notched cards to facilitate summing of data is, of course, not confined to experiments with factors having any particular number of levels. For example, by the use of cards with a double row of holes a three-level factor could be handled by (i) notching only into the first row ("shallow punch") for level 1, (ii) notching into both rows ("deep punch") for level 2, and (iii) not notching at all for level 3. By this means the three sums required for

(Concluded on page 10)

ITEM	HOLE	Sum_1	Sum_2	$\frac{(DIFFERENCE)^2}{N}$	F_1	SIGNIFICANCE	F_2	SIGNIFICANCE
A	1							
B	2							
C	3							
D	4							
E	5							
F	6							
AB	7							
AC	8							
AD	9							
AE	10							
AF	11							
BC	12							
BD	13							
BE	14							
BF	15							
CD	16							
CE	17							
CF	18							
DE	19							
DF	20							
EF	21							
ABC	22							
ABD	23							
ABE	24							
ABF	25							
ACD	26							
ACE	27							
ACF	28							
ADE	29							
ADF	30							
AEF	31							
BCD	32							
BCE	33							
BCF	34							
BDE	35							
BDF	36							
BEF	37							
CDE	38							
CDF	39							
CEF	40							
DEF	41							
ABCD	42							

	D.F.	SUM OF SQUARES	MEAN SQUARE	STAND. DEV.
REPLICATES				
POOLED RESIDUAL$_1$				
POOLED RESIDUAL$_2$				

$\Sigma x^2 =$

$(\Sigma x)^2 =$

$\bar{x} =$

TOTAL SUMS OF SQUARES $= \Sigma x^2 - \frac{(\Sigma x)^2}{N}$

Figure 2—Analysis Chart for 2^n Factorial Experiments Using Edge-notched Cards

Attribute Sampling When Defects Are Not Randomly Distributed*

IRVING W. BURR

FRANK G. NORRIS

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The Problem and its Importance

When separate discrete units make up a lot and each unit is to be judged either good or defective, the method of sampling is clear, namely, to take a random sample of the units. The same can also be said, when the total number of defects among a sample of, say, n units is to be determined, even though here there may be several defects on a single unit. On the other hand, the problem is much more difficult when the lot consists of continuously extended material. Examples of such materials are metal strip or wire in coils, paper in rolls, and yard goods in bolts. One of the complicating features is that the defects may come in bunches or other patterns. A second complication is that the only part of a coil or roll which we can get at is the beginning or the end, unless we are willing to ruin the coil or roll for normal uses.

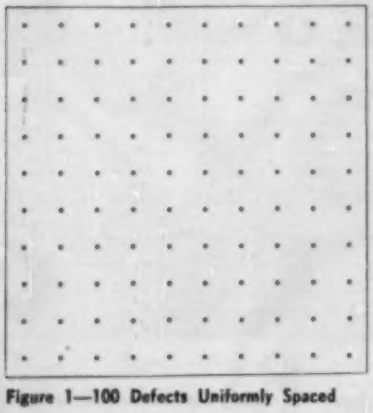

Figure 1—100 Defects Uniformly Spaced

We shall be concerned with the first complication, that is, how best to sample when judging a lot

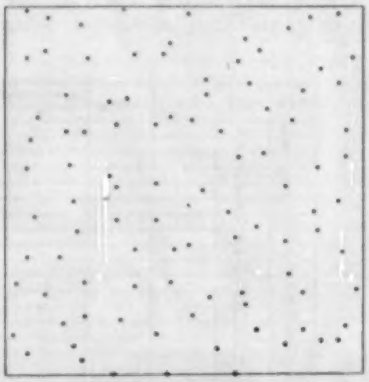

Figure 2—100 Defects Randomly Located Within Uniformly Spaced Areas

for acceptance or control. The problem arises because the suitability of existing methods is questioned.

What Is A Defect?

The normal concept of a defect is that it is some attribute of the product which is undesirable from the customer's viewpoint. Ideally each kind of defect should be so clearly defined that independent observers will reach identical conclusions as to whether or not any given irregularity is a "defect." Such definitions depend upon economic considerations, intended use of product, custom, etc.

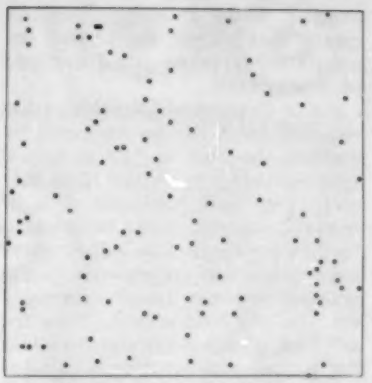

Figure 3—100 Defects Randomly Spaced

All the foregoing is merely current practice. What we have reference to in this article goes further. We shall see that the definition of a defect or a defective should not only depend upon the foregoing, but also upon the methods of sampling used to estimate lot quality or to justify an acceptance-rejection decision. Thus, we might call a cluster of small defects, for example, pits on a plate: (a) one defect, (b) many, by counting the number of pits, or (c) two defects if the cluster ruins two areas or pieces of potential finished product.

The intimate relation among sampling methods, patterns of defects, and reliability of results is our problem. Thus, as we shall see, some seemingly reasonable sampling methods, when applied to typical non-random patterns of defects can give results widely different from those expected from Poisson or binomial distributions. Furthermore, such results from apparently logical sampling methods may easily give thoroughly erroneous conclusions as to lot quality.

Sampling Random and Non-Random Patterns of Defects

To illustrate various patterns of defects, Figures 1 to 6 were constructed. We may think of the areas shown as sheets 10 × 10 inches. Figure 1 shows a perfectly uniform distribution of defects with exactly one in each of the 100 one-inch squares, into which the large square might be cut.

*Outgrowth of a panel of the Metals Technical Committee at the Annual Convention of the American Society for Quality Control, May 24, 1955.

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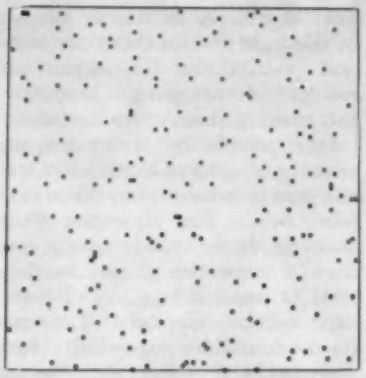

Figure 4—200 Defects Randomly Spaced

Figure 5—100 Defects Linear Pattern

Figure 6—100 Defects Cluster Pattern

Many persons would think that Fig. 2 has a more random pattern of defects than has Fig. 3. But such is not the case. Figure 3 is a random pattern of 100 defects. These dots were placed on the main square by random numbers. Thus the 10 inches horizontally and vertically were each divided into 100 spaces. Then a random 2-digit number gave the horizontal coordinate and the next 2-digit number give the vertical coordinate for the first point, which is therefore located in a random position in the large square. All

TABLE I—Distribution of Defects Within the 100 Square Sample Areas Completely Covering the Main Area

Number of defects per unit sampling area	Expected Frequency (Poisson Law)	Observed Frequency				
		Uniformly Spaced Fig. 1	Random in each Area Fig. 2	Completely Random Fig. 3	Linear Pattern Fig. 5	Cluster Pattern Fig. 6
0	36.8	0	0	37	52	83
1	36.8	100	100	38	13	2
2	18.4			17	20	2
3	6.1			6	13	5
4	1.5			0	2	0
5	0.3			2		2
6	0.1					0
7						2
8						1
9						1
.						
.						
.						1
16						
.						
.						
.						
22						1
Total	100.0	100	100	100	100	100

100 points of Fig. 3 were located in this way. On the other hand Fig. 2 is "seeded", that is, there is exactly one defect in each one inch square, but instead of being placed at the precise middle as in Fig. 1, the location of each defect in Fig. 3 is at random within its own one inch square.

Figure 4 was obtained in the same way as Fig. 3, but with twice as many defects at random. Figures 5 and 6 show two rather frequently occurring types of defect patterns: strings and clusters. The same general types of defect patterns can be applied to a wire which is essentially one-dimensional rather than two. In this case short lengths of wire, say one inch, would correspond to the one inch squares. There is also the possibility of studying defects distributed in the different ways in three-dimensional product.

Now consider various ways of sampling the sheets for defects. Figure 7 shows a fixed-pattern or regular method of sampling. This pattern may or may not be effective, depending upon the way in which the defects tend to group. The total area of all ten circles is ten percent of the large square area. Another method is to take ten such circles as in Fig. 7, but to decide upon the location of the center by random numbers. Thus the centers were located as were the dots in Fig. 3. Figure 8 shows such a distribution of circles. Another method is to take at random ten of the 100 possible one-inch squares.

Now consider the distributions of defects shown in Table I. Here the distribution commonly used is the Poisson. The expected frequencies of numbers of defects are shown in the second column. The sampling was simply to take the 100 possible one-inch squares. Only one of the five defect patterns gave Poisson results. The cluster and linear patterns both give radically different results and yet these are practical distributions of defects. Hence sampling decisions based upon the Poisson distribution as a model simply are not sound.

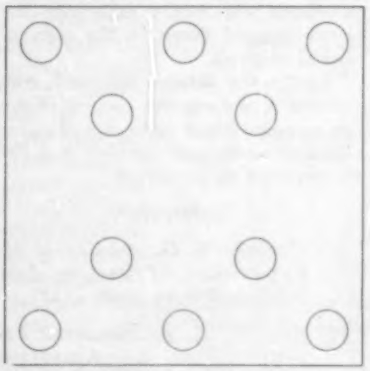

Figure 7—Sampling Plan, Ten Percent of Area, Regular Spacing

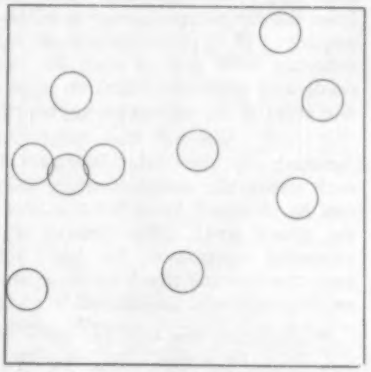

Figure 8—Sampling Plan, Ten Percent of Area, Random Location of Samples

TABLE II—Distribution of Defects Within Ten Circles Covering Ten Percent of Area, With Fixed Pattern (Fig. 7)

Number of defects per Unit Sampling Area	Expected Frequency (Poisson Law)	Observed Frequency				
		Uniformly Spaced Fig. 1	Random in Each Area Fig. 2	Completely Random Fig. 3	Linear Pattern Fig. 5	Cluster Pattern Fig. 6
0	3.7	10	4	5	4	7
1	3.7		3	2	2	2
2	1.8		3	2	2	
3	0.6			1	2	
4	0.2					
.....	.....	.....	.....	.....	.....	.....
17						1
	10.0	10	10	10	10	10

Table II shows a fixed pattern sampling of each of the defect patterns. Because of the small number, ten, of samples, results are perhaps not so conclusive, though the cluster pattern with its 17 is far too rare to ever occur by chance by the assumed Poisson.

Table III shows the same defect patterns as sampled by random circles covering ten percent of the total area. The distribution for the cluster pattern is completely off from the Poisson and missed all defects. The other distributions are quite non-Poisson.

Table IV shows results in sampling 200 defects on the main area. Results again show strong departures from the Poisson distributions.

Thus we see that the Poisson distribution simply is not applicable if we sample in the ways shown.

What Can Be Done

The solution to the problems presented in the previous section lies in changing the sampling plan according to (a) the use which is to be made of the material, and (b) the manner in which the defects are likely to run or group. In the light of this there are several possibilities for improving results of sampling inspection and making them more useful.

One possibility is to inspect areas or lengths of material of the size that is to be used in the actual fabrication. For example, if a sheet is to be made into caps, then in inspection it may be possible to count how many of these caps will be defectives. Thus we do not count how many individual pinholes and other defects we find, but only the number of potential caps which contain one or more defects. A cluster of fifty defects might still make only one cap defective. Lot quality is then stated as the proportion of defective caps, rather than as the raw count of defects. In this way, defects within the chosen sample areas, which may be far from a Poisson distribution, might still give good binomial results if handled as we have just described.

Now in the choice of sampling areas to count as defective or good, we would like to have areas placed just as they would be for the caps to be made. This may not be possible, for example, because of the sizes of the caps varying in different orders. In such a case we can take a sampling area made up of a number of small areas the typical or average size of caps, and count the

TABLE III—Distribution of Defects Within Ten Circles, Covering Ten Percent of Area, With Random Location (Fig. 8)

Number of Defects per Unit Sampling Area	Expected Frequency (Poisson Law)	Observed Frequency				
		Uniformly Spaced Fig. 1	Random in Each Area Fig. 2	Completely Random Fig. 3	Linear Pattern Fig. 5	Cluster Pattern Fig. 6
0	3.7	0	2	3	5	10
1	3.7	8	4	6	2	
2	1.8	2	4	1	2	
3	0.6				1	
4	0.2					
	10.0	10	10	10	10	10

Use of Edge-Notched Cards in the Analysis of Variance

(Continued from page 7)

the analysis of a factor with three levels could be obtained.

It has been found practical and convenient to analyze two tables of data (e.g., two dependent variables from the same experiment) simultaneously. This is accomplished by entering both sets of data on the cards and collecting sums on opposite sides of the calculator keyboard.

If only half of the data are summed, in the determination of each effect, the complementary sum can be obtained by difference from the grand total. This reduces the summing operations by half but loses the running check on the arithmetic previously mentioned.

A geometric use can be made of the deck of cards. By observing which holes are mutually notched (by edgewise viewing), the confounding of an experiment can be verified very rapidly.

This method of analysis is so simply and rapidly performed that it has proved very useful in introducing statistical experimentation to workers who might otherwise become bogged down in the conventional analysis.

Lastly, the data on the cards constitute a permanent record of the experiment in a form which lends itself to additional calculation if this is required in the future.

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(3) DeLury, D. B., "On the Design of Experiments," *Industrial Quality Control*, Vol. X, No. 4, Jan., 1954, p. 24-29. (This article discusses the theory involved in assigning positive and negative signs in the analysis of data.)

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(5) Casey, R. S., and Perry, J. W., *Punched Cards* (Their Application to Science and Industry), Reinhold Publishing Co., New York, 1951

(6) Yates, F., "The Design and Analysis of Factorial Experiments," *Tech. Comm. No. 35*, Imperial Bureau of Soil Science, Harpenden, England, 1937, p. 15-16

fraction defective or such areas, not the total number of defects they contain.

In the foregoing there may be economic factors which come in and make any defect, like a pinhole, so troublesome that it is more economical to throw away a whole sheet. If this is the case then a single sheet might be the sample unit.

Another possibility is to let "one defect" be defined as to be a cluster or scratch or other imperfection which can be contained entirely in one unit area. If the patch or cluster is too big for one such area to enclose it, but two adjacent areas will, then it counts as two "defects." A grid of square areas can be made and the number of defects is defined as the fewest number of such square areas which can be made to enclose the given irregularity. A count of such defects can then more confidently be expected to be Poisson in distribution.

TABLE IV—Distribution of Defects Within Sample Areas, 200 Random Defects (Fig. 4)

Number of Defects per Unit Sampling Area	Expected Freq. in 100 (Poisson Law)	Observed Frequency		
		One Hundred One Inch Squares	Circles With Fixed Pattern	Circles With Centers at Random
0	13.5	12	1	1
1	27.1	27	4	1
2	27.1	28	2	3
3	18.0	21	2	5
4	9.0	8	0	
5	3.6	3	1	
6	1.2	1	0	
7	0.4	0	0	
8	0.1	0	0	
	100.0	100	10	10

General rules are difficult to give, because of the many economic and engineering factors entering in, together with the different patterns of defects. But in many practical cases sounder judging of lot quality can be obtained in the ways we have discussed.

Some situations have been cited which quite evidently do not conform to the assumptions that are the basis of the Poisson Distribution. This lack of conformance does not mean that the general philosophy of inspection by sampling cannot be applied to these products. A clear understanding of the product requirements offers a basis of modification of the procedure, that can be expected to be as mutually helpful to both producer and consumer of continuously extended products (and possibly other cases) as the plans now in use have proved to be for distributions of defects that conform to the basic assumptions of standard plans.

Some Remarks on the Problem of Tolerance Limits

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Introduction

In the mass production of any product, the quality of which is measured by some characteristic X, variation from item to item of product is the rule rather than the exception. Such variation may be due to certain assignable causes or may be of a random (chance) nature. Shewhart[6] has proposed methods by which the existence of assignable causes may be detected. We shall, for the purposes of this article, assume that such methods have been employed and the proper corrective measures utilized. Thus the process with which we shall be concerned is assumed to be in a state of "statistical control", that is, we assume only random variation is present. Under such conditions, one of the more important statistical problems is the determination of tolerance limits within which a certain proportion of the total production may be expected to fall.

The problem of setting tolerance limits was defined by Wilks[9] as follows. Let the population of X values be described by the probability density function $f(X)$, or by the cumulative distribution function $F(X)$ where

$$F(X_0) = P(X \leq X_0) = \int_{-\infty}^{X_0} f(X)\, dX \qquad (1)$$

If a random sample of a size n is obtained we wish to find two functions of the sample values, $L_1(X_1,\ldots,X_n)$ and $L_2(X_1,\ldots,X_n)$, such that

$$P\left\{F(L_2) - F(L_1) \geq \beta\right\} = \alpha \qquad (2)$$

To define our terms we shall call L_2 the *upper tolerance limit*, L_1 the *lower tolerance limit*, β the *population coverage*, and α is of the nature of a confidence coefficient. If the limits L_1 and L_2 are independent of the form of the probability density function (that is, if

they are valid for all possible probability density functions), they will be referred to as *distribution-free* tolerance limits. If the limits L_1 and L_2 are dependent upon the functional form of the probability density function but are independent of the parameters of the postulated probability density function, they will be known as *parameter-free* tolerance limits.

Wilks[9] gave a distribution-free solution based on order statistics. He set $L_1 = X_{(1)}$ and $L_2 = X_{(n)}$, where $X_{(1)}$ and $X_{(n)}$ denote, respectively, the smallest and largest values in a random sample of size n. The question of most interest to quality control workers is, of course, how large a sample need be taken to satisfy equation (2) if α and β are given values. Setting

$$V = F(X_{(n)}) - F(X_{(1)}) \tag{3}$$

the distribution of V is given by

$$g(V) = n(n-1)\, V^{n-2}\,(1-V);\ 0 < V < 1,\quad n \geq 2 \tag{4}$$

and hence, for given α and β, the sample size may be determined by solving (for n) the equation

$$n(n-1)\int_{\beta}^{1} V^{n-2}\,(1-V)\,dV = \alpha \tag{5}$$

or

$$n\beta^{n-1} - (n-1)\,\beta^{n} = 1 - \alpha \tag{6}$$

Some illustrative solutions are: (i) if $\alpha = 0.95$ and $\beta = 0.99$, $n = 472$, (ii) if $\alpha = 0.97$ and $\beta = 0.90$, $n = 50$, (iii) if $\alpha = 0.72$ and $\beta = 0.95$, $n = 50$, and (iv) if $\alpha = 0.09$ and $\beta = 0.99$, $n = 50$.

The particular solutions exhibited above point out the problem with which this note is concerned. In selecting α and β, one introduces a certain amount of arbitrariness—the choice of α and β is, of course, the prerogative of management and is thus seldom considered a statistical problem. The implications of this arbitrary selection of values for α and β may be seen upon examination of the illustrative solutions given earlier. Suppose one obtains a random sample of size 50—is one interested in a 90 percent coverage with 97 percent confidence or in a 99 percent coverage with 9 percent confidence? We may say, of course, that this it not a statistical problem and thus dismiss it. However, this is not a realistic point of view. Although the problem may not be statistical in nature, it is one with which a statistician must concern himself if he is to be of service. The following methods of selecting sample size are proposed in the hope that they will throw more light on the general situation.

Solution for β Fixed, α Varying

Suppose in equation (2) we assume that β is fixed. This gives us a relationship between α and n, and it seems reasonable to choose as the desired value of n that value at which α begins increasing at a decreasing rate. It is to be noted that we no longer have a statistical decision problem (even in the classical sense) as we in no way account for type II errors. On the other hand, we are saying that equation (2) is the best test procedure and making our problem a strictly probabilistic one. Similar values of n could be found for other test procedures relating to the problem posed. In such strict probabilistic attempts, cost is taken into account implicitly but the notion of "loss function" is omitted.

However, assuming equation (2) is "best" in some acceptable sense and using Wilks' distribution free solution, let us determine the value of n at which α begins to increase at a decreasing rate (see eqn. 6) for fixed β. Setting

$$\frac{d^2\alpha}{dn^2} = \frac{d^2}{dn^2}\left\{1 - n\beta^{n-1} + (n-1)\,\beta^{n}\right\} = 0 \tag{7}$$

we obtain

$$n = -\left[\frac{2}{\ln\beta} + \frac{\beta}{1-\beta}\right] \tag{8}$$

where [x] stands for the greatest integer less than or equal to x.

"Risk Function" Approach

Suppose we have a non-negative weight function $W(L_1, L_2)$ which represents the loss sustained by using the tolerance limits L_1 and L_2, and a cost function $C(n)$ which represents the cost of n observations. We then define a *risk function*

$$r(n) = E\left\{W(L_1, L_2)\right\} + C(n) \tag{9}$$

and it seems reasonable to choose as our solution that value of n which minimizes $r(n)$.

For example, if $L_1 = X_{(1)}$ and $L_2 = X_{(n)}$, it should be reasonable to assume that the loss is a function only of $V = F(X_{(n)}) - F(X_{(1)})$. The reasonableness of such an assumption is seen once we note that it would be the case if the loss involved is the same if an item of product exceeds the upper limit as it is if an item of product is below the lower limit. To consider a specific case, suppose that $W(V) = k\,(V^{-a} - 1)$, and suppose further that the cost of taking observations is a linear function $C(n) = c_1 + c_2 n$. Then

$$r(n) = n(n-1)k\int_{0}^{1}(V^{-a} - 1)V^{n-2}\,(1-V)dV + c_1 + c_2 n$$

$$= \frac{a(2n-a-1)}{(n-a)\,(n-a-1)}\,k + c_1 + c_2 n \tag{10}$$

and

$$\frac{d\ r(n)}{dn} = c_2 + k\left\{\frac{2a(n-a)\,(n-a-1) - a(2n-a-1)\,(2n-2a-1)}{(n-a)^2(n-a-1)^2}\right\} \tag{11}$$

Setting this derivative equal to zero we may solve for a *positive* value of n, say n_0, which minimizes $r(n)$. This may be done, for given a, c_2 and k, by using standard numerical methods. Since such a solution will more than likely be non-integral, the required sample size will be taken as either the largest positive integer less than n_0 or the smallest positive integer greater than n_0, the choice depending on the curvature of $r(n)$ in the neighborhood of n_0.

It is evident that many different weight functions might be chosen, most of which would lead to different solutions. For example, a somewhat simpler weight function than the one considered above is $W(V) = k\,(1-V)$. In such a case

$$r(n) = n(n-1)k\int_{0}^{1}(1-V)^2\,V^{n-2}\,dV + c_1 + c_2 n$$

$$= \left\{2k/(n+1)\right\} + c_1 + c_2 n \tag{12}$$

for which the minimum solution is

$$n_0 = \sqrt{2k/c_2} - 1 \qquad (13)$$

As an illustration of the case of the weight function $W(V) = k(1-V)$, consider the following: an article is produced in large lots of N; the producer takes a sample of n from the lot, determines the sample-minimum $X_{(1)}$ and maximum $X_{(n)}$, and sells the lot with a money-back guarantee that the characteristic X is between $X_{(1)}$ and $X_{(n)}$. Assuming that every unit with X not between $X_{(1)}$ and $X_{(n)}$ will be turned in for refund, the loss will be proportional to

$$N\left[1 - \left\{F(X_{(n)}) - F(X_{(1)})\right\}\right] = k(1-V).$$

Clearly it is impossible to avoid some degree of arbitrariness when choosing particular weight (and/or cost) functions. However, if sufficient data on inspection and other costs are available, a reasonable choice should be possible.

One-sided Tolerance Limits

Wilks[9] also considered the problem of setting just an upper (lower) tolerance limit since this situation arises rather frequently in quality control work. He suggested that the largest (smallest) value in the sample be assigned as the upper (lower) tolerance limit. In this case

$$g(V) = nV^{n-1};\ 0 < V < 1 \qquad (14)$$

where $V = F(X_{(n)})$ when considering the upper tolerance limit and $V = 1 - F(X_{(1)})$ when considering the lower tolerance limit. Hence the sample size may be determined by solving (for n) the equation

$$n\int_{\beta}^{1} v^{n-1}\,dV = \alpha \qquad (15)$$

or

$$1 - \beta^n = \alpha \qquad (16)$$

which gives

$$n = \frac{\ln(1-\alpha)}{\ln \beta} \qquad (17)$$

If in (16) we assume β to be fixed and seek the value of n at which α begins to increase at a decreasing rate we see that, for $n > 0$, α is always increasing at a decreasing rate. Thus no solution similar to that given by equation (8) exists for the case of an upper (lower) tolerance limit.

However, if we consider the weight function $W(V) = k(V^{-a} - 1)$ and the cost function $C(n) = c_1 + c_2 n$, we obtain

$$r(n) = kn\int_{0}^{1}(V^{-a} - 1)\,V^{n-1}\,dV + c_1 + c_2 n$$

$$= \frac{ka}{n-a} + c_1 + c_2 n \qquad (18)$$

This leads to the minimum risk solution

$$n_0 = a + \sqrt{ka/c_2} \qquad (19)$$

If we had considered the weight function $W(V) = k(1-V)$ and the cost function $C(n) = c_1 + c_2 n$, then

$$r(n) = kn\int_{0}^{1}(1-V)\,V^{n-1}\,dV + c_1 + c_2 n$$

$$= \left\{k/(n+1)\right\} + c_1 + c_2 n \qquad (20)$$

for which

$$n_0 = \sqrt{k/c_2} - 1 \qquad (21)$$

Summary

Two alternative approaches to the problem of determining sample size in connection with Wilks' tolerance limits have been suggested. Each approach appears to have merit from a practical point of view and further investigation of the properties of each is underway.

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SUPERVISOR'S CIRCLE

PAUL A. ROBERT, *Editor*

Gruen Watch Company, Time Hill, Cincinnati, 6, Ohio

The Use of Optical Comparators and Contour Projectors in Industry

J. J. SCHOONOVER, *IBM Corporation, Endicott, N. Y.*

IT IS my opinion, based on experience, that industry can purchase its fair share of inexpensive inspection by the use of optical comparators and contour projectors, providing it recognizes certain limiting factors, learns how to overcome them, and considers the increase in flexibility that can be obtained by use of clever devices to broaden the scope of these instruments.

In the hope that my experience with optical comparators may benefit others, I shall list some of the limiting factors and what can be done about them, and some of the methods that can be used to improve flexibility and scope. I will also outline a maintenance program.

• Factors that may limit the use of a comparator, and what can be done about them.

1. The side of the comparator screen may be a limiting factor. A 7 or 12 inch screen certainly could not be used for a dimension of 1 inch at 20X magnification without some modification of a standard comparator. By the same token, if all or a major portion of the parts to be checked are small and dimensions are at the magnification required within the limits of a 7 inch screen, it would be impractical to purchase the more costly 30 inch comparator. The answer to this situation is not to attempt to tool the shop until a survey has been made to determine which area includes the major portion of practical applications. It is more than likely that several sizes of comparators will be found useful.
2. Table travel limitations. This can be offset by the type of tooling used to stage the work (see methods to increase the scope of comparator use).
3. Magnifications versus part tolerance may appear to be a limiting factor. This may be a misconception. For instance, it might be thought that a larger magnification would permit the operator to be more certain of his readings. This is not always true, for as magnification increases, the light-gathering power is reduced, which causes a fringe area that makes the projection hazy instead of giving a clear, sharp definition of image. It is better to use established methods of determining the magnification to be used, such as the following:

Magnification	*Tolerance*
10X	0.0076
20X	0.0038
31.25X	0.0024
50X	0.0015
62.50X	0.0012
100X	0.0008

4. The accuracy of the equipment available for making and checking charts may limit the use of comparators.
   It is desirable to be able to check the charts to an accuracy of 0.0005 inches. Part tolerances of less than 0.0001 inches should not be used, unless there is available a comparator that has been considerably modified from standard. The reason for making this statement is the fact that when two different people set up different comparators, there is the possibility of a human error of 0.0005 inches which can be in opposite directions, totaling 0.001 inches.
5. The use of duplicate fixtures limits the ability to hold fixtures and masters alike.
6. Width of surface to be gaged could be a limiting factor.
   To take care of this, there are several types of tooling that can be used, such as knife-edge locaters, or rollers, etc.
   The above-mentioned limiting factors may cause some concern. On the other hand, there are many advantages which recommend the use of comparators.

• Items that promote the use of comparators.

1. A torque meter mounted on a staging fixture used in conjunction with a grid chart makes a fast method of checking deflection in inches versus pressure in oz., lbs., gr., etc., and also provides a fast visual check of how much set the part takes.
2. Tumble blocks (or blocks with several locating sides on which

Comments of the Editor

For many years, the author was in charge of the Gage Laboratory at the IBM plant in Endicott, New York and his company is one of the largest users of optical comparators in this country.

The Endicott plant also pioneered in the field of operator inspection and has adapted this instrument to this program.

Several years ago Dorian Shainin's pre-control techniques were experimentally adapted to optical comparators in the Endicott Plant, and today are successfully being used to control the dimensional accuracy of many parts at the machine.

The author has indicated to the editor his willingness to discuss comparator inspection with any of our readers and to show them the inspection system at the Endicott plant if they would like to pay him a visit.

a part is mounted) is an economical type of tooling to maintain and offers the advantage of making possible the checking of several dimensions with one set-up.

3. Reticules of glass in use with charts, and two light sources, increase the flexibility of the comparator.
4. An indexing rack fixture for staging work makes it possible to check several points on a part in one set-up. In order to convert to other similar parts, all that is necessary is a different master rack adapted to the same fixture.
5. Two light sources—one a vertical beam, one a horizontal beam—using two different color filters—can give a contrast that makes the matching of a sample part with a known master possible.
6. Photo-electric cells used in conjunction with an inexpensive comparator can be helpful in solving some unusual problems in inspection.
7. Turreted lens systems save much time and reduce the cost of lens maintenance.
8. The versatility possible with projection equipment is the reason that these comparators can serve inspection needs with dollar economy in operation. The base unit is indispensable. Beyond this, tooling can be as simple or elaborate as desired to achieve the inspection efficiency required. Only inexpensive fixed stages are needed for holding parts, whereas something more elaborate, such as a gear analyzer, may be required for laboratory work. The extent of accessory equipment depends on the diversity of work to be done. In any event, only a few minutes of time are required to change fixtures to accommodate various types of work. In comparing the cost of tooling on comparators versus good mechanical gages, experience has shown that it is possible to tool approximately four jobs on a comparator for the price of one mechanical inspection set-up. The comparator method also has the additional advantage of much faster inspection with less skilled operators.

• Maintenance of Comparators.

A good maintenance program is essential for peak efficiency. Fol-

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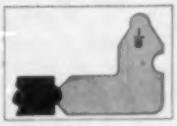
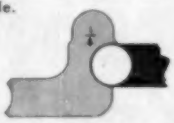


3. Determines convex radius near projection that prevents use of gage as in views 2 and 5.

4. Checks any concave radius that is ½ or less of circle.



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No. 77C	24 gages (Sets 77A and 77B Combined)
No. 77CX	25 gages (Sets 77AX and 77B Combined)
No. 77D	16 gages 1/32 to ½ by 32nds
No. 77E	8 gages 9/16 to 1 by 16ths
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lowing are some suggestions for this program.

1. Cleanliness is important. Have trained personnel, preferably from the Gage Inspection Department, clean and oil lead screws, weights, screen, mirror, etc., on a periodic basis.
2. Furnish the operator with equipment and instructions for checking the magnification. This should be done several times a day and at the start of each job or at any change in set-up.
3. Have only competent people change lens systems or change magnification.
4. Keep air jets away from lens and mirrors.
5. Locate comparator away from busy aisles where damage may result from interdepartmental trucking or handling by curious people passing through the department.
6. Changing bulbs should be handled by trained personnel. This can affect magnification; there is also a safety hazard to the person making the change unless he is trained in the operation.
7. Locate comparator to take advantage of the shaded or dark areas in the department. This assists in getting a finer definition on the screen.
8. Have a scheduled inspection for all charts and fixtures.

If the items covered in this article are taken into consideration, comparators and contour projectors can be an extremely valuable item in economical inspection.

Problems Department

THOMAS A. BUDNE
PAUL C. CLIFFORD
Co-editors

P. C. Clifford, 39 Norman Road, Montclair, N. J.

New Problems:

Problem 19. Submitted by E. J. Brazill, Baltimore, Md.

The development of products such as the electronics computer and the guided missile have introduced new quality control problems. These products are highly complex systems and may contain several thousand individual purchased components such as tubes, resistors, capacitors, relays, etc. in each complete system. The failure of even one such component may result in the failure of the entire system. Along with this increasing complexity have come unprecedented requirements of high reliability of performance. This requirement is understandable in the case of the one-shot guided missile or the complex computer in which a failure would require hours of trouble-shooting, or give incorrect answers.

One particular problem arises from the fact that many of the components must be purchased under existing standards and specifications which specify the use of MIL-STD-105A sampling tables with specific AQL's. However, if a system contained only 50 tubes, (or any other component whose individual failure would result in failure of the entire system) whose quality was no better than a specified AQL of 1 percent defective, then only 60 percent or less of the completed systems could be expected to operate without failure. Furthermore, with smaller samples for smaller lots giving increased risks of accepting poorer quality, there can be even less assurance of high reliability of performance.

It appears then, that there is an inconsistency between the requirements of high reliability and the requirement that MIL-STD-105A sampling tables should be used. To state that any specific percent defective is acceptable (AQL) is almost contradictory to the objective of maximum reliability. It seems that a return to a specified Dodge-Romig LTPD, setting a fixed consumers' risk of accepting poor quality would be more appropriate.

I believe that it would be most enlightening to myself and to others who are faced with this problem if the Problems Department might be used as a forum for its discussion.

(Editors' note: This sounds like a good idea to us. You'd better get your thoughts in before we start filling all the space with our own.)

Problem 20. Submitted by Louis Wilson, Metropolitan Section.

When cutting an outside dimension our shop people are in the habit of working to the high side of the tolerance (or to the low side of tolerance for an inside dimension) with the argument that pieces outside of tolerance on the high side can

One of the clear specifications the editors of this department have with the editor is that they shall edit—not solve. The solution given to problem 13 is an exception. We have a feeling that someone has a better solution, but we have not been able to locate that someone. Rather than let the problem go with no solution we have published the few comments we were able to gather. We feel that the problem is of more importance than the solution, so perhaps we may restate it in general terms. Suppose the tolerance width is ten units. Parts one or two units outside the specification limits may be usable. If an AQL of 2 percent were specified, and if the defective parts were of this sort, probably no defective assemblies would be found. However parts that are 5 or 6 units outside the specifications would be of a different nature. They would cause failure or fail to assemble. How do you, in your sampling plans, distinguish between these two types of defectives? Despite our so-called solution, we will be glad to publish some real solutions to problem 13.

On the other hand maybe 13 is just not our lucky number.

be reworked, whereas pieces under the lower tolerance limit must frequently be scrapped.

There is certainly some justification for this argument in that the loss incurred in scrapping an undersized piece is usually much higher than the cost of reworking an oversized piece. In a particular situation in which the tolerance spread was unavoidably equal to only 5 standard deviations of the process capability, keeping the process centered and in control meant that about 0.6 percent of the pieces (at best) would be oversized and an equal number would be undersized. Since the estimated cost of reworking an oversized piece was $2.00 and the estimated loss in scrapping an undersized piece on which several previous operations had been performed was about $20.00, the average cost of rework and scrap per 100 pieces manufactured was $13.20. The out of tolerance pieces are picked up in the first assembly operation.

However, we found that if the process was centered at a point which was 0.5 standard deviations above the nominal value (toward the rework side), then we could expect 2.3 percent of the pieces to be oversized and about 0.1 percent of the pieces to be undersized with an average cost of $8.60 per 100 pieces for scrap and rework. While the percent of pieces out of tolerance went from 1.2 percent to 2.4 percent, the cost of scrap and rework went from $13.20 down to $8.60 per hundred pieces. The 0.5 standard deviations seems to give a minimum cost. However, we computed it by trial and error and would like to know if there is a formula which would quickly give the most economical point at which to center a process for any given similar situation.

Suggested Solutions:

Problem 13. (May 1955)

In talking with numerous people in the electronics and electron tube industries, we haven't found anyone with a specific answer to Dr. Wagner's question. He had asked whether there were any sampling plans being used in the U.S.A. which would specifically detect a concentration of early or short life lamps mixed in with a lot of normal life lamps.

The problem is not unknown to people who work with electron tubes. However, the problem appears to be generally handled through an aging of tube types in which this is a problem so that short life tubes are killed off. In some companies, large samples or all tubes are X-Rayed to

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It was suggested that the Lot Plot plan may be particularly applicable to Dr. Wagner's problem. Since the short life lamps are those which fall below 0.2 of the specified minimum, any large concentration of such lamps would be readily seen in the Lot Plot. As the percent of such lamps in the lot decreased, the ability to detect them would also decrease, but then the urgency in making this detection would also decrease. This is true of any sampling plan.

Problem 15. (June 1955) Suggested by M. Daly, New York, N. Y.

Mr. Dalton's question relating to frozen peas can at least be partially answered in the following way:

Let n_s = number of sinkers in a beaker sample of 50 peas

n_f = number of floaters in a beaker sample of 50 peas

p_s = Percent of sinkers among the floaters in a production sample of size n_1

p_f = Percent of floaters among the sinkers in a production sample of size n_2

An estimate of the sinkers, as a percent of all peas, which production will classify as floaters is given by the expression:

$$s = p_s n_f/50 \qquad (1)$$

Similarly an estimate of the floaters, as a percent of all peas, which production will classify as sinkers is given by the expression:

$$f = p_f n_s/50 \qquad (2)$$

An estimate of the total error of classification is:

$$t = p_s n_f + p_f n_s/50 \qquad (3)$$

For purposes of control, expressions (1) and (2) may serve as appropriate indicators with the following approximate 3 sigma limits:

$$\bar{s} \pm 3\,\frac{\sqrt{\bar{p}_s^{\,2}\,\sigma_{n_f}^{\,2} + \bar{n}_f^{\,2}\,\sigma_{p_s}^{\,2}}}{50}$$

$$\bar{f} \pm 3\,\frac{\sqrt{\bar{p}_f^{\,2}\,\sigma_{n_s}^{\,2} + \bar{n}_s^{\,2}\,\sigma_{p_f}^{\,2}}}{50}$$

where $\sigma_{n_f}^{\,2} = 50\,\frac{\bar{n}_f}{50}\left(1 - \frac{\bar{n}_f}{50}\right)$

$$\sigma_{n_s}^{\,2} = 50\,\frac{\bar{n}_s}{50}\left(1 - \frac{\bar{n}_s}{50}\right)$$

$$\sigma_{p_s}^{\,2} = \frac{\bar{p}_s\,(1-\bar{p}_s)}{n_1}$$

$$\sigma_{p_f}^{\,2} = 50\,\frac{\bar{p}_f\,(1-\bar{p}_f)}{n_2}$$

and $\bar{p}_s$ and $\bar{p}_f$ are weighted averages of past values of p_s and p_f percents, respectively.

Since the sample sizes n_1 and n_2 may vary considerably from one production sample to the next, it may be necessary to recompute the control limits for different sample sizes as is usually done with p charts with varying sample sizes.

BOOK REVIEWS

W. D. Baten, Editor

26 University Drive, East Lansing, Mich.

DIRECTORY OF CONSULTANT MEMBERS, American Management Association, Inc., 1515 Broadway, Times Square, New York 36, N.Y., 1956. Reviewed by Harmon S. Bayer.

This is a publication which lists the management consulting firms in which one or more AMA members are owners or part owners. According to the introduction, the publication is not intended to be an endorsement of the listed firms by the AMA. The list is alphabetical and in addition according to the classifications of the major breakdowns of services. An excellent section is included titled "SELECTING AND WORKING WITH A CONSULTANT."

STRENGTHENING SUPERVISORY AND EXECUTIVE PERFORMANCE, by R. C. Ingersoll, C. E. Evans, T. W. Prior, E. H. Reed, Dr. R. T. Collins, M. H. Baker, American Management Association, New York, 1956, 63 pages. Reviewed by J. R. Seip.

"Needed: Depth in Management" states several truisms, the aspirations of nearly every management, some odd age group statistics, criticism of our educational system and pleasure that so many are enrolled in it.

"Getting the Facts About Supervisors and Their Jobs" provides several key approaches to satisfy staff problems relative to the topic. Precise, timely and useful.

"Executive Apprenticeship: the Time for Sound Training" outlines the famed Goodyear training programs. Modestly told despite the deserved fame based on results.

"A Practical Plan for Executive Development" freshly attacks the Never-Never Land of unrealistic paper development programs designed to please: the eye, the purse, the time limit fixed, or the preconceived opinions of their subscribers. The plan described is worth serious review.

"The Man in the Gray Flannel Suit—As a Psychiatrist Sees Him" is another long cool look at the men far enough up the ladder to be hurt by falling. It surveys socio-economic shifts in opinion and emphasis in the past several decades to demonstrate psychostatic pressure growths and stress points. The remedial advice is equally interesting.

"Integrity in Business" mentions technical manpower shortage, educational shortcomings, technological dislocation problems, and concern over certain business malpractices. The article notes American material superiority to the (cultural) Greek golden age, and contains a real surprise for Roman history scholars.

The reader will feel, "something should be done about it; what, really, is going to be done about it?" Blaming the low 1930's birthday for the shortage of technical personnel rather than the lack of incentive these people encounter, does not negate many worthwhile suggestions incorporated.

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Committee Meetings Schedule

(All rooms are at Hotel Sheraton-Cadillac unless otherwise stated)

TIME	DATE & MEETING	ROOM
	WEDNESDAY, MAY 22	
7:30 am	Breakfast	
	Mr. Ott & Committee Chairmen	Parlor H
	Mr. Fisher & Committee Chairmen	Parlor G
2:30 pm	Meeting	
	Operations Research Committee	Parlor G
	Standards Research Committee	Parlor I
4:35 pm	ANNUAL MEETING OF THE SOCIETY	Cathedral (Masonic Temple)
6:30 pm	Dinner and Annual Meeting	
	Administrative Applications Division	Reception
	Aircraft Division	Parlors G-H-I
	Automotive Division	Normandie
	Chemical Division	Parlor C
	Electronics Division	Pan American
	Metals Technical Committee	Sheraton
7:30 pm	Meeting	
	All Section Officers	English
	THURSDAY, MAY 23	
7:30 am	Breakfast	
	Education & Training Committee	Parlor H
9:00 am	Meeting	
	Examining Committee	Parlor G
	Constitution Committee	Parlor I
	Awards Committee	Sheraton
2:30 pm	Meeting	
	"NEW" Board of Directors	Parlor H
	Saddoris Award Committee	Parlor G
	Historical Committee	Sheraton
	Vendor-Vendee Relations Committee	Parlor I
4:35 pm	Annual Meeting	
	Textile Division	Oak Room (Masonic Temple)
9:30 pm	Meeting	
	Editorial Board	Parlor H
	FRIDAY, MAY 24	
7:30 am	Breakfast	
	Program & Speakers Committee	Parlor H
9:00 am	Meeting	
	Boston Program Planning Group	Sheraton
	Membership Committee	Parlor I
	International Cooperation Committee	Parlor G
2:30 pm	Meeting	
	"OLD" Board of Directors	Parlor H
	Bibliography Committee	Parlor G
	Applied Methodology Committee	Parlor I
	SATURDAY, MAY 25	
9:00 am	Meeting	
	1957-58 Executive & Operating Committee	Parlor H
	General Convention Committee	Sheraton

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PROGRAM

	Period I—Wed. A.M., May 22, 10:30-11:30	Period II—Wed. P.M., May 22, 2:00-3:00, 3:30-4:30	Period III—Thurs. A.M., May 23, 9:00-10:00, 10:3
A	**GENERAL INTEREST** **Speaker:** JULIAN H. TOULOUSE, Owen-Illinois, Toledo, Ohio **Subject:** **"Finding the Facts Before Setting the Specifications—Methods"** **Moderator:** EDWARD M. SCHROCK, American Radiator & Standard Sanitary Corporation, New York, New York	**GENERAL INTEREST** **Speaker:** FRANK CAPLAN, JR., Westinghouse Electric Corp., Cheswick, Pennsylvania **Subject:** **"Process Control in a Job Shop"** **Speaker:** HARMON S. BAYER, Quality Control Consultant, Detroit, Michigan **Subject:** **"Quality Control Applied to a Job Shop"** **Moderator:** CHARLES R. KENDEL, Lamson & Sessions Co., Cleveland, Ohio	**GENERAL INTEREST** **Speaker:** CHARLES A. BICKING, The Carb[illegible]um Co., Niagara Falls, New York **Subject:** **"The Team Approach in Installing [illegible]ity Control"** **Speaker:** WILLIAM J. MASSER, The General [illegible]tric Co., Schenectady, New York **Subject:** **"The Quality Manager and Quality [illegible]** **Moderator:** JOSEPH M. JURAN, Consulting Eng[illegible] Tuckahoe, New York
B	**APPLIED METHODOLOGY** **Speaker:** PAUL S. OLMSTEAD, Bell Telephone Laboratories, Whippany, New Jersey **Subject:** **"The Science of Quality Control as an Operation"** **Moderator:** BENJAMIN EPSTEIN, Wayne State University, Detroit, Michigan	**AUTOMOTIVE** **Speaker:** BRENT C. JACOB, JR., [illegible]neapolis-Moline Co., Minneapolis, Minnesota **Subject:** **"Automotive Division First "Report on Machine Tool Capability Studies"** **Moderator:** ROBERT O. TAPLER, Chrysler Corp., Detroit, Michigan **Speaker:** R. W. GARDNER, Ford Motor Co., Dearborn, Michigan **Subject:** **"Quality Control in a Foundry"** **Moderator:** H. E. COLLINS, Ford Motor Co., Dearborn, Michigan	**AUTOMOTIVE** **Speaker:** DONALD E. HART, General Motors [illegible] Detroit, Michigan **Subject:** **"The Digital Computer and Its Ap[illegible]tions"** **Moderator:** DONALD M. SPATH, General Pro[illegible] Corp., Jackson, Michigan **Speaker:** JOHN L. KING, Ford Motor Co., [illegible]born, Michigan **Subject:** **"Consumer-Supplier Quality Problem[illegible] Relations"** **Moderator:** THOMAS J. ANDERSON, JR., Ford M[illegible] Co., Livonia, Michigan
C	**AIRCRAFT** **Speaker:** RALPH D. HUMPHRIES, Cessna Aircraft Company, Wichita, Kansas **Subject:** **"Quality Control and Shop Efficiency"** **Moderator:** E. C. BENNETT, Northrop Aircraft, Inc., Hawthorne, California	**AIRCRAFT** **Panel:** A. BEDFORD, Redstone Arsenal, Huntsville, Alabama R. F. MAHACHEK, Department of the Navy, Washington, D.C. JOHN W. YOUNG, North American Aviation, Inc., Los Angeles, California H. O. WILLIAMS, Douglas Aircraft Co., Inc., Santa Monica, California **Subject:** **"Quality Control's Obligation to Management and Customer on Reliability of Complex Weapons"** **Moderator:** J. Y. McClure, Convair, Division of General Dynamics, Fort Worth, Texas **Speaker:** V. G. MOSER, Civil Aeronautics Administration, Muskegon, Michigan **Subject:** **"The CAA Program in Quality Control"** **Moderator:** DAVID A. HILL, Hughes Aircraft Co., Culver City, California	**AIRCRAFT** **Speaker:** HERBERT B. EPSTEIN, Chance V[illegible] Aircraft Corp., Dallas, Texas **Subject:** **"Organizing for Aircraft Quality Con[illegible]** **Moderator:** H. EARLE MOORE, McDonnell Air[illegible] Corp., St. Louis, Missouri **Speaker:** ERVIN F. TAYLOR, Westinghouse El[illegible] Corp., Cheswick, Pa. **Subject:** **"Discovery Sampling by Attributes—[illegible]visions, Reviews, and Results"** **Moderator:** ROY A. WYLIE, Minneapolis-Honey[illegible] Regulator Co., Freeport, Illinois
D	**CHEMICAL** **Speaker:** F. X. DONOHUE, The Nestle Co., Inc., White Plains, New York **Subject:** **"Statistical Application in the Control of High Speed Filling Machines"** **Moderator:** CHARLES B. WAY, Green Giant Co., Le Sueur, Minnesota	**CHEMICAL** **Panel:** EDWIN C. HARRINGTON, JR., Monsanto Chemical Co., Springfield Massachusetts DONALD S. McARTHUR, Esso Research & Engineering Co., Elizabeth, New Jersey CUTHBERT DANIEL, Consultant, New York, New York GEORGE E. P. BOX, Princeton University, Princeton, New Jersey **Subject:** **"Research Strategy"** **Moderator:** GERTRUDE M. COX, University of North Carolina, Raleigh, North Carolina	**CHEMICAL** **Speaker:** KARL F. LANG, H. J. Heinz Co., P[illegible] burgh, Pennsylvania **Subject:** **"Problems and Pitfalls in Accept[illegible] Sampling of Glass Containers"** **Speaker:** DAVID R. PERYAM, Quartermaster [illegible] & Container Institute, Chicago, Illino[illegible] **Subject:** **"Factors Affecting the Accuracy and [illegible]liability of Sensory Tests"** **Speaker:** OTTO DYKSTRA, JR., General Foods C[illegible] Hoboken, New Jersey **Subject:** **"Application of Scheffe's Metho[illegible] Paired Comparisons in Food Qu[illegible] Evaluation"** **Moderator:** AMIHUD KRAMER, University of M[illegible] land, College Park, Maryland
E	**METALS** **Speaker:** JOHN HROMI, United States Steel Corp., Monroeville, Pennsylvania **Subject:** **"Some Fractional Factorial Experiments"** **Moderator:** PHILLIPS WHIDDEN, Aluminum Company of America, Pittsburgh, Pennsylvania	**METALS** **Panel:** W. T. ROGERS, United States Steel Corp., Lorain, Ohio FREDERICK C. YOUNG, Ford Motor Co., Dearborn, Michigan WILLIAM P. GOEPFERT, Aluminum Company of America, Pittsburgh, Pennsylvania GROVER C. BALDWIN, Scovill Manufacturing Co., Waterbury, Connecticut ROBERT D. MUIR, Lundberg Screw Products Co., Lansing, Michigan KENNETH G. COOK, The Thomas & Betts Co., Elizabeth, New Jersey **Subject:** **"Vendor-Vendee Relationship Problems Associated with the Metals Industries"** **Moderator:** WADE R. WEAVER, Republic Steel Corp., Cleveland, Ohio	**GENERAL INTEREST** **Speaker:** H. C. HAMAKER, N. V. Philips Gloei[illegible] pen Fabrieken, Eindhoven, Netherlan[illegible] **Subject:** **"Experimental Design in Industry"** **Moderator:** ELLIS R. OTT, Rutgers University, [illegible] Brunswick, New Jersey **METALS** **Speaker:** C. JAN YNGSTROM, Domnarfvet S[illegible] Works, Domnarvet, Sweden **Subject:** **"Reporting and Analysing Productio[illegible] a Swedish Steel Plant"** **Moderator:** DOUGLAS H. W. ALLAN, American [illegible] & Steel Institute, New York, New Y[illegible]
F	**ADMINISTRATIVE APPLICATIONS** **Speaker:** MORRIS H. HANSEN, Bureau of Census, Washington, D.C. **Subject:** **"Statistical Aids to Management"** **Moderator:** HARMON S. BAYER, Quality Control Consultant, Detroit, Michigan	**BASIC CONCEPTS** **Speaker:** JOSEPH MOVSHIN, Thompson Products, Inc., St. Louis, Missouri **Subject:** **"SQC Training Courses—Session 'A'—In-Plant"** **Moderator:** RUDOLPH FREEDMAN, Alco Valve Co., St. Louis, Missouri **Speaker:** RUDOLPH FREEDMAN, Alco Valve Co., St. Louis, Missouri **Subject:** **"SQC Training Courses—Session 'B'—A.S.Q.C. Section"** **Moderator:** JOSEPH MOVSHIN, Thompson Products, Inc., St. Louis, Missouri	**BASIC CONCEPTS** **Speaker:** MAX ASTRACHAN, Air Force Insti[illegible] of Technology, Dayton, Ohio **Subject:** **"Sampling by Variables I—1-Way [illegible]tection on X"** **Speaker:** FRED C. LEONE, Case Institute of Te[illegible] nology, Cleveland, Ohio **Subject:** **"Sampling by Variables II—2-Way [illegible]tection on X"** **Moderator:** GEORGE W. McDERMOTT, Delco-Re[illegible] Div., General Motors Corp., Ander[illegible] Indiana
G	**VENDOR—VENDEE RELATIONS** **Speakers:** HARRY M. ROSENBLATT and WILLIAM W. WOLMAN, Department of the Navy, Washington, D.C. **Subject:** **"The New Military Standard for Inspection by Variables"** **Moderator:** WILLIAM R. PABST, JR., Department of the Navy, Washington, D.C.	**VENDOR—VENDEE RELATIONS** **Speaker:** JACK MANNION, Northrop Aircraft, Inc., Hawthorne, California **Subject:** **"Vendor-Vendee Multi-Purpose Data System"** **Moderator:** JOHN J. RIORDAN, Department of Defense, Washington, D.C. **APPLIED METHODOLOGY** **Speaker:** W. G. COCHRAN, Johns Hopkins University, Baltimore, Maryland **Subject:** **"Combining the Information from Several Experiments"** **Moderator:** CECIL C. CRAIG, University of Michigan, Ann Arbor, Michigan	**APPLIED METHODOLOGY** **Speaker:** D. L. WALLACE, University of Chica[illegible] Chicago, Illinois **Subject:** **"Multiple Comparisons in the Analysis [illegible] Variance"** **Moderator:** WILLIAM D. BATEN, Michigan St[illegible] University, East Lansing, Michigan **Speaker:** FRED A. BEELER, Western Michigan C[illegible] lege, Kalamazoo, Michigan **Subject:** **"Some Useful Non-Parametric Sign[illegible] ance Tests"** **Moderator:** FRED C. LEONE, Case Institute of Te[illegible] nology, Cleveland, Ohio
H	**TEXTILE** **Speaker:** W. RALPH STROTHER, Ford Motor Co., Dearborn, Michigan **Subject:** **"Quality Requirements of Automotive Fabrics"** **Moderator:** DAME S. HAMBY, North Carolina State College, Raleigh, North Carolina	**TEXTILES** **Speaker:** C. H. KARNES, Burlington Industries, Inc., Greensboro, North Carolina **Subject:** **"Quality Problems of Automotive Fabrics from the Producer's Point of View"** **Moderator:** J. H. REYNOLDS, Statistician, Rome, Georgia **ELECTRONICS** **Speaker:** FRANK H. SQUIRES, Topp Industries, Inc., Los Angeles, California **Subject:** **"Quality Control from Bench to Budget"** **Moderator:** AUGUST B. MUNDEL, Sonotone Corporation, Elmsford, New York	**ELECTRONICS** **Speaker:** M. SOBEL, and S. S. GUPTA, Bell Te[illegible] phone Laboratories, Inc., Allento[illegible] Pennsylvania **Subject:** **"Selection and Ranking Problems w[illegible] Binomial Populations"** **Moderator:** HARRY G. ROMIG, Summers Gyrosc[illegible] Co., Santa Monica, California **Speaker:** R. H. Hinrichs, Convair, Division of G[illegible] eral Dynamics, San Diego, California **Subject:** **"The Determination of Circuit Perfor[illegible] ance Variation Using Digital Computer"** **Moderator:** ROBERT G. FITZGIBBONS, Bendix Av[illegible] tion Corp., Mishawaka, Indiana

VENTION PROGRAM

PROGRAM

Period IV—Thurs. P.M., May 23, 2:00-3:00, 3:30-4:30	Period V—Fri. A.M., May 24, 9:00-10:00, 10:30-11:30	Period VI—Fri. P.M., May 24, 2:00-3:00
GENERAL INTEREST **Speaker:** DANIEL G. MECKLEY, III, York Corporation, York, Pennsylvania **Subject:** **"Inspection and Quality Control—Then and Now"** **Speaker:** HARRY G. ROMIG, Summers Gyroscope Co., Santa Monica, California **Subject:** **"Use of Management Reports in a Quality Control Program"** **Moderator:** BEN H. LLOYD, Leetham, Simpson & Elliott, Ltd., Montreal, Quebec, Canada	**GENERAL INTEREST** **Speaker:** W. S. TANDLER, Warner & Swasey Research Corp., New York, New York **Subject:** **"Automatic Gaging of Complex Parts by Tape Controls, Etc."** **Speaker:** R. V. JOHNSON, Johnson Gage Co., Bloomfield, Connecticut **Subject:** **"Statistics, Quality, & Control: The Essential Trio for Modern Competitive Production"** **Moderator:** ERVIN E. SCHIESEL, Mattatuck Manufacturing Co., Waterbury, Connecticut	**GENERAL INTEREST** **Speaker:** WINTHROP W. SPENCER, The General Electric Co., Schenectady, New York **Subject:** **"This Is Inspection Automation"** **Moderator:** KERMIT C. BROWN, American Seating Co., Grand Rapids, Michigan
MANUFACTURING AND ASSEMBLY **Speaker:** CHARLES W. CARTER, Rath & Strong, Boston, Massachusetts **Subject:** **"Quality Control of Visual Characteristics"** **Speaker:** FRANK J. SINDELAR, International Business Machines, Poughkeepsie, New York **Subject:** **"Quality Control in Complex Systems"** **Moderator:** PAUL A. ROBERT, The Gruen Watch Co., Cincinnati, Ohio	**AUTOMOTIVE** **Speaker:** JULIUS MEHALEK, The Budd Company, Philadelphia, Pennsylvania **Subject:** **"Statistical Quality Control in Automotive Stamping Production"** **Speaker:** EDWARD R. CLARK, General Motors Corp., Ypsilanti, Michigan **Subject:** **"AQL's Are Half the Story"** **Moderator:** HOWARD R. BOLTON, General Motors Corp., Lockport, New York	**AUTOMOTIVE** **Speaker:** W. FRANK LYNN, Ford Motor Co., Ypsilanti, Michigan **Subject:** **"Quality Control in the Manufacturing of Automotive Electrical Systems"** **Moderator:** DONALD M. SPATH, General Products Corporation, Jackson, Michigan
AIRCRAFT **Speaker:** WILLIAM A. MacCREHAN, JR., Bendix Aviation Corp., Towson, Maryland **Subject:** **"Evaluating Vendor Quality"** **Moderator:** FRANK CAPLAN, JR., Westinghouse Electric Corp., Cheswick, Pennsylvania **BREWING** **Speaker:** ALEX G. NACY, Lone Star Brewing Co., San Antonio, Texas **Subject:** **"Managerial Statistics Applied to the Brewing Industry"** **Moderator:** WILLIAM H. von MEYER, Barry-Wehmiller Machinery Co., St. Louis, Missouri	**BREWING** **Speaker:** ROBERT H. BAUKNECHT, Rahr Malting Co., Manitowoc, Wisconsin **Subject:** **"A Malting Company Looks at Specifications Through Statistics"** **Moderator:** ROBERT I. TENNEY, Wahl-Henius Institute, Chicago, Illinois **Speaker:** LINDSON P. ANDERSON, Armour & Company, Chicago, Illinois **Subject:** **"The Elementary Statistical Approach Saves Money"** **Moderator:** J. S. RANDALL, Anheuser-Busch, Inc., St. Louis, Missouri	**METALS** **Speaker:** WALTER T. HAYTER, Youngstown Sheet & Tube, East Chicago, Indiana **Subject:** **"Process & Quality Control in a Steel Plant"** **Moderator:** MARJORIE M. BASKERVILLE, Dominion Foundries & Steel, Ltd., Hamilton, Ontario
CHEMICAL **Speaker:** MAYNARD S. RENNER, Dewey & Almy Chemical Co., Cambridge, Massachusetts **Subject:** **"Some Considerations in the Reel Sampling of Paper"** **Speaker:** DuWAYNE R. CARLSON, The Gardner Board and Carton Co., Middletown, Ohio **Subject:** **"Quality Control in the Carton Plant"** **Moderator:** RICHARD S. BINGHAM, JR., The Carborundum Company, Niagara Falls, New York	**CHEMICAL** **Speaker:** J. C. Dickson, Humble Oil & Refining Co., Baytown, Texas **Subject:** **"Operations Analysis of Optimum Shipping Tankage"** **Speakers:** WILLIAM C. VISSING, Eli Lilly & Co., Indianapolis, Indiana; KARL BAUER, Abbott Laboratories, North Chicago, Illinois **Subject:** **"Improving Efficiency in Sorting Operations"** **Moderator:** MARTIN A. BRUMBAUGH, Bristol Laboratories Inc., Syracuse, New York	**CHEMICAL** **Speaker:** W. M. WOODING, American Cyanamid Co., Stamford, Connecticut **Subject:** **"Statistical Studies of Rosin Sizing Evaluation Variables: IV Guide to the Comparison and Selection of Evaluation Procedures"** **Moderator:** EUGENE C. YEHLE, University of Michigan, Ann Arbor, Michigan
METALS **Speaker:** WILLIAM E. BRAMER, John A. Roebling's Sons Corporation, Trenton, New Jersey **Subject:** **"Quality Control in Production of Enamelled Magnet Wire"** **Moderator:** JAMES A. CURRY, Kaiser Steel Corp., Fontana, California **Speaker:** THOMAS P. DAVIS, Allegheny-Ludlum Steel Corp., Watervliet, New York **Subject:** **"Quality Assurance in the Manufacture of Valve Steel"** **Moderator:** H. T. OATMAN, Allegheny-Ludlum Steel Corp., Brackenridge, Pennsylvania	**METALS** **Speaker:** JOHN V. STURTEVANT, United States Steel Corporation, Pittsburgh, Pennsylvania **Subject:** **"Variability of Mechanical Properties of Flat-Rolled Product"** **Moderator:** JOHN W. W. SULLIVAN, American Iron & Steel Institute, New York, New York **STANDARDS** **Speaker:** ROBERT E. BENSON, Continental Folding Paper Box Co., Inc., Ridgefield, New Jersey **Subject:** **"Developing Quality Standards and Quality Ratings in Carton Manufacture"** **Moderator:** RALPH E. WAREHAM, Ralph E. Wareham & Associates, Chappaqua, New York	**STANDARDS** **Speaker:** WILLIAM P. CLOYES, Titanium Metals Corporation of America, New York, New York **Subject:** **"Initiating Quality Control and Quality Standards for New Products"** **Moderator:** RALPH E. WAREHAM, Ralph E. Wareham & Associates, Chappaqua, New York
ADMINISTRATIVE APPLICATIONS **Speaker:** JOHN M. ALLDERICE, Eastman Kodak Co., Rochester, New York **Subject:** **"Designing the Measurement and Analysis of Work"** **Speaker:** CHARLES R. HICKS, Purdue University, Lafayette, Indiana **Subject:** **"Quality Control Applied to Industrial Engineering"** **Moderator:** CHARLES A. BICKING, The Carborundum Company, Niagara Falls, New York	**ADMINISTRATIVE APPLICATIONS** **Speaker:** W. EDWARDS DEMING, New York University, New York, New York **Subject:** **"On the Contributions of Standards of Sampling to Legal Evidence"** **Speaker:** L. SWANSON, Arthur Anderson & Co., Chicago, Illinois **Subject:** **"Operations Research in Business and Industry"** **Moderator:** HOWARD L. JONES, Illinois Bell Telephone Co., Chicago, Illinois	**ADMINISTRATIVE APPLICATIONS** **Speaker:** DORIAN SHAININ, Rath & Strong, Inc., Boston, Massachusetts **Subject:** **"Controlling the Quality of Management Decisions"** **Moderator:** HARMON S. BAYER, Quality Control Consultant, Detroit, Michigan
ARMED SERVICES **Speaker:** A. F. CASSEVANT, Department of the Army, Washington, D.C. **Subject:** **"Plans and Programs for Procurement Quality Control"** **Speaker:** WARREN S. KOONTZ, Department of the Navy, Washington, D.C. **Subject:** **"Storage Surveillance and Quality Control"** **Moderator:** EDWARD M. SCHROCK, American Radiator & Standard Sanitary Corp., New York, New York	**ARMED SERVICES** **Speaker:** C. A. PETERSON, Department of the Air Force, Wright-Patterson Air Force Base, Ohio **Subject:** **Quality Control Relationship to Reliability of Product"** **Speaker:** JOHN J. DUNN, Department of Defense, Washington, D.C. **Subject:** **"Standardization and Quality Control"** **Moderator:** MASON WESCOTT, Rutgers University, New Brunswick, New Jersey	**ARMED SERVICES** **Speaker:** W. K. GHORMLEY, Department of Defense, Washington, D.C. **Subject:** **"Contract Requirements and Quality Control"** **Moderator:** ALFRED L. DAVIS, Rochester Institute of Technology, Rochester, New York
ELECTRONICS **Speaker:** MICHAEL GEBRIAN, Sperry Gyroscope Co., Long Island, New York **Subject:** **"Engineering & Design of Test Equipment for Complex Electronic Products"** **Moderator:** IRVIN W. SCHOENINGER, Globe-Union, Inc., Milwaukee, Wisconsin **Speaker:** RUDOLF F. DRENICK, Radio Corporation of America, Camden, New Jersey **Subject:** **"Basic Measures of Reliability"** **Moderator:** HAROLD F. DODGE, Bell Telephone Laboratories, Inc., New York, New York	**BASIC CONCEPTS** **Speaker:** GAYLE W. McELRATH, University of Minnesota, Minneapolis, Minnesota **Subject:** **"Sampling by Variables III—Protection on Variability"** **Speaker:** R. L. STORER, Phillips Petroleum Co., MacGregor, Texas **Subject:** **"Sampling by Variables IV—Available Sampling Tables"** **Moderator:** GEORGE W. McDERMOTT, Delco-Remy Div., General Motors Corp., Anderson, Indiana	**ELECTRONICS** **Speaker:** HENRY I. MATOSOFF, Kwikset Locks Inc., Anaheim, California **Subject:** **"An Industrial Engineering Approach to Quality Control"** **Moderator:** THOMAS LUCAS, Globe-Union Inc., Milwaukee, Wisconsin

REGISTRATION FORM

ELEVENTH ANNUAL CONVENTION, AMERICAN SOCIETY FOR QUALITY CONTROL

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All 3 days	ea. _____ $19.00	_____ $10.00	_____
Wednesday Only	ea. _____ 8.00	_____ 5.00	_____
Thursday Only	ea. _____ 8.00	_____ 5.00	_____
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_____	Social Evening Wednesday	ea. 2.00	_____
_____	Ladies' Program	ea. 6.00	_____
_____	TRANSACTIONS (Not included in any of the above)	ea. 3.00	_____
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TECHNICAL SESSIONS PERIOD

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B							
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G							
H							

Please indicate by an X in the appropriate boxes, which sessions you plan to attend. This will assist in planning room space.

Detach and mail this form with your check to:
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NOTE: If you are making reservations for more than one person, please provide all requested information for each person on additional sheets, using a sheet for each individual.

REGISTER IMMEDIATELY: If, after making reservations, you cannot attend, your registration fee will be refunded provided the Registrar is notified before 12 Midnight, Monday, May 20, 1957.

HOTEL RESERVATION FORM

1957 A.S.Q.C. CONVENTION—DETROIT, MICHIGAN—MAY 22, 23, 24, 1957

Convention Headquarters—Sheraton-Cadillac

(Check type of Accomodation desired)

CHOICE OF HOTELS	☐ Single Room Daily Rates	☐ Double Room Daily Rates	☐ Twin Bedroom Daily Rates	☐ Suites (2 Room) Daily Rates
Detroit Leland ☐	$ 6.50 to $11.50	$ 9.00 to $14.00	$10.00 to $17.50	
Fort Shelby ☐	5.25 to 10.25	6.75 to 12.75	7.75 to 14.75	$20.50 to $22.50
Park Shelton ☐	7.00 to 14.00	10.50 to 17.00	11.00 to 17.00	25.00 to 35.00
Sheraton-Cadillac ☐	7.00 to 14.50	13.25 to 18.00	15.35 to 20.50	25.00 to 32.00
Tuller ☐	5.00 to 10.00	7.50 to 12.00	10.00 to 14.00	22.00 to 30.00

The Tuller also has ☐ Rooms for 3—$10.50 to $15.00 and ☐ Rooms for 4—$12.00 to $16.00

ARRIVAL DATE: _____ TIME: _____ DEPARTURE DATE: _____

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DETROIT CONVENTION AND TOURIST BUREAU
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Eleventh Annual Exhibition Displays

Booth 1

KARL HEITZ, INC.

Techniques of close-up photography, copywork, microscopic photography, and general photography with the Swiss precision-built ALPA 35mm camera will be demonstrated by Karl Heitz, Inc. The very same ALPA which serves the amateur to perfection in pursuit of his hobby is also a precision recording tool in the hands of the scientist and research engineer.

Also on display will be: Projectina-portable combination macro-microscopic viewer-projector-camera; Kern Swiss microscopes; Omag pocket microscopes; Bleeker microscopes; Bleeker pocket spectroscopes; and Abbe-refractometer.

Booth 4

FRIDEN CALCULATING MACHINE CO., INC.

Highlight of the Friden booth will be the pictorial and product display of Friden's role in data processing as related to summary and analysis for statistical quality control. Equipment on display at the booth includes the Friden add punch machine for integrated data processing as well as the Friden Model SRW, world's only fully-automatic—touch one key—square root calculator.

Statistical quality control educational matter on standard deviation, coefficient of correlation, probable errors, and application information for adaptation of add punch to processing of quality control data will also be available.

Booth 5

A. G. DAVIS GAGE & ENGINEERING CO.

The A. G. Davis Gage & Engineering Co. booth will exhibit its complete line of gage components for use in process and design engineering. These include: flush pin components for use in special built-up fixture gage design; indicator type gage pin assemblies for use in special built-in fixture gage design; flush pin gage blanks for checking large diameter countersinks; new models of barrel and bar type flush pin gage blanks; and new models of indicator mounting units.

Booth 7

REPUBLIC GAGE CO.

Thread gages, gages, and more gages will be displayed in Booth 7. There will be thread, plain cylindrical, pipe, special, and carbide ring thread gages. Also on display will be thread and gear measuring wires and master setting discs.

Booth 8

INTERNATIONAL BUSINESS MACHINES CORP.

IBM's APR equipment, providing a new, fully-integrated system designed specifically for the automatic collection of production data at the source of manufacturing operations, fills a long-standing need in industry wherever continuous process production line methods or job shop operations are in use.

Fast and flexible, APR can express itself both in machine and human language. It has the ability to collect, correlate, store and record accurate, up-to-the-minute production data in punched tape and cards, while printing out reports for supervisors on automatic typewriters located along the production line. The card and tape media, containing such variables as weight, count, length, and temperature, together with related information identifying the product and process, are used as input to accounting machines.

Booth 10

CUSTOM SCIENTIFIC INSTRUMENTS, INC.

SCI's booth will feature instruments and tools for the plastics, insulation, adhesive, and metals field. The units to be displayed are:

1. Dial Indicator Calibrator—for checking and calibrating the accuracy of dial indicators.
2. Templin Calibrator—for checking and calibrating the accuracy of extensiometers, strain gauges, and test indicators.
3. CSI Microscope Stage (traveling microscope)—range 3"W × 12"L × 4¾"H for inspection, study, and coordinate measurement of various kinds.
4. CSI Dividing Head—for profiling, drilling, light milling, layout work and engraving.
5. Rotary Table—for use with an optical compariter and as part of special set up for tool makers.
6. Guarded Hot Plate (Alundum) Range—100 degrees F. to 1400 degrees F. (ASTM C177-45) determining the coefficient of thermal conductivity of various materials.
7. The Pittsburgh Corning Thermal Conductivity Probe, Range—minus 50 degress F. to plus 200 degrees F.—for determining the coefficient of thermal conductivity of various materials.
8. Peel Test Apparatus (MIL-STD-401A)—for determining the comparative peel resistance of adhesive bands between facing cores of sandwich constructions.

Booth 11

TRIPLETT & BARTON, INC.

A feature of the Triplett & Barton booth will be display of the "TRI-IND-X" 275 KVP portable industrial x-ray unit.

Booth 12

FOSTER ENGINEERING CO.

The Foster gage for visual grinding size control on external grinding machines, the Foster indicating snap gage which is used for checking and inspection after the operation has been completed, and the Foster "Electrosizer" gage will be on display. Briefly stated, the "Electrosizer" gage will provide automatic control of cylindrical grinding operations and retract the wheelslide automatically when the work reaches size.

Booth 14

JONES & LAMSON MACHINE CO.

The Jones & Lamson Co. will display a newly designed 14 inch table model comparator and measuring machine together with charts and fixtures for general optical inspection. A 14 inch pedestal comparator with a newly developed method of fine pitch gear inspection will also be displayed.

HOTEL RESERVATIONS

Detach the *lower third* of the opposite page and fill in *all* the required information. Indicate your alternate preferences of hotels and accommodations by placing the numerals 1, 2, and 3 in the appropriate hotel boxes and a check mark (√) in the box indicating the type of accommodations desired. Mail the completed form to the HOUSING BUREAU, DETROIT CONVENTION AND TOURIST BUREAU, 626 Book Building, Detroit 26, Michigan.

Should the requested rooms in the hotels you selected be reserved prior to the receipt of your reservation, the Housing Committee will assign you comparable accommodations elsewhere. The hotel accepting your reservation will confirm directly to you.

IMPORTANT: Reservations mailed to the Convention Bureau must be received not later than May 6th. While the Convention Bureau will try to handle requests received after that date, room commitments made by the hotels will have lapsed, and there can be no guarantee that reservations can be made. Confirmed reservations will be held by the hotel only until 6:00 pm of the arrival date unless later arrival time is specified.

Booth 17

BROWN & SHARPE MFG. CO.

Precision tools and gages, super vernier tools, electronic measuring equipment, Johansson gage blocks and accessories, dial indicators, height setting tools, permanent magnet chucks, black granite surface plates and accessories, ground flat stock—all of these standard Brown & Sharpe products will be displayed in Booth 17. In addition, some of the new products which Brown & Sharpe will be exhibiting include; radius and fillet gages, direct reading micrometers, magnetic V blocks, a line of black frame micrometers, planer & shaper gages, ¾" micrometer heads, 8 × 24 inch flat stock, and "Thrift" Johansson gage blocks.

Booth 52

BASIC SERVICE CORP.

Products made by companies for whom the Basic Service Corp. acts as Michigan sales representative will be exhibited in Booth 52. These will be the Audigage and Vidigage Ultransonic Thickness Gages (Branson Instruments, Inc.), various sizes of ultrasonic generators (Branson Ultrasonic Corp.), static balancing machines (Taylor Dynamometer & Machine Co.), and sensitive precision drilling machines (Taylor Dynamometer & Machine Co.).

Redesigned ultransonic generators and Vidigage Automation Converter & Recorders as well as the new redesigned air operated static balancing machines will also be exhibited.

All of the equipment shown will be operating and available for demonstration.

Booth 53

UNIT PROCESS ASSEMBLIES, INC.

This exhibit will display the new Dermitron Non-Destructive Thickness Tester for the measurement of coating of metals on metals, non-conductors on metals, and metals on non-conductors. Several Dermitron Instruments will be in continuous demonstration on measurement of various coatings.

Booth 60

THE BRISTOL CO.

Bristol's complete line of socket screw products are quality controlled from receipt of raw material through finished product packaging by use of the most modern instruments, gages, and statistical control methods. The Bristol exhibit will illustrate their quality controlled process by means of a flow diagram of the screw production lines and examples of statistical control sheets, actual small gages, and representations of larger instruments and gages used in their process. Samples of all types of socket screws manufactured by the Bristol Co. will be available for inspection. Since 1913, the Bristol Co. has been a leading producer of socket screw products for industry and military applications, and features both the well-known Bristol Multiple-Spline socket screw as well as standard hex socket products.

Booth 54

THE ELECTROMARK CORP.

The Electromark equipment marks any metal permanently, very quickly, and economically without distorting the surface. They will display this equipment which consists of power supply units to deliver the small amount of current necessary, electrolytes which cause a chemical reaction with the metal, and stencils which allow the design to be reproduced on metal.

Booth 56

THE MARTIN CO.

The theme of the Martin Co. exhibit will be "Research and Development in Quality Control." The exhibit will portray through pictures, graphs, testing instruments, and words the team effort at Martin between quality control, engineering, and manufacturing research. Martin's program of process development of quality control from design through development, engineering, manufacturing research to production is believed to be unique in industry. Under this program new processes are being generated and old processes being investigated in order to keep quality control in pace with new manufacturing methods.

Booth 58

THE JOHNSON GAGE CO.

The Johnson Gage Company, Booth No. 58, will exhibit a complete line of gages and comparators for checking both internal and external screw-threads, together with accessories and attachments for checking the concentricity and squareness of related surfaces.

Roll and segment type gages and comparators will be shown for both internal and external thread checking. These are the company's conventional RING-Snap, ROLL-Snap, and Tri Roll, fixed and indicating models.

The Pivotal PLUG-Snap Gages and Comparators, together with the new Wheel-Snap Comparator, for internal thread checking, will be featured.

Exacting requirements for the checking of turbine blade dovetails and serrations have resulted in the development of a complete line of new comparators for this vital inspection and will be on display.

The company's owner-management devotion and ingenious approach to and comprehension of the art and science of thread gaging is reflected in this exhibit. This development and research, resulting in some one hundred patents, domestic and foreign, has placed the company in the enviable position of being able to offer the most complete line of thread checking equipment in the world. This "know how" for correct application is in back of every installation whether it be a single unit or a complete gaging program.

Booth 62

HAMILTON WATCH CO.

The Allied Products Div. of the Hamilton Watch Co. will again display the Kwik-Chek Precision Hole Gage. Kwik-Chek gages are valuable time-savers to anyone concerned with precision measurements—machinists, tool & die makers, engineers, inspectors, etc.—from the model shop on thru production to quality control and inspection. Modifications, increasing the present applications, will be introduced at the exhibit. In addition, a wide variety of Hamilton's precision engineered components, timing instruments, and other special services will be displayed.

Booth 66

THE WARNER & SWASEY RESEARCH CORP.

The "PROBOMAT Automatic Control Units" for precision positioning of machine tools, with tape, card, and Pre-Set programming will be on display at the Warner & Swasey booth. Along with this, they will be displaying uses of the PROBOMAT tape or card programmed automatic precision measuring machine. This machine automatically compares the nominal dimensions with the actual dimensions of the part and assorts the parts on a "go-no-go" gage principle.

The AUTOMATIC AIR FOIL PROBOGRAPH, Model MP-15, an instrument for the mass inspection of parts with airfoil surfaces, such as turbine buckets, compressor blades and vanes, will also be displayed.

Booth 70

THE DOALL CO.

Sponsor of "The story of measurement" exhibit, and responsible for its presentation, is The DoALL Co. Three-dimensional display panels, Cinemascope slides and accompanying lecture will be featured twice daily in a "little theatre."

There are no "hands off" signs at the display tables, which will be exhibited in DoALL's Booth No. 70, and visitors are encouraged to handle the latest precision measuring tools used for control of quality by modern manufacturers. These include electrical and mechanical comparators—capable of detecting deviations as small as one millionth of an inch which are another of industry's solutions to the problem of checking precision parts on a production basis. Optical flats used with monochromatic light generators, show interference bands of light, by which minute variations in flatness, size and finish can be interpreted into linear measurement. Diorite (black granite) surface plates, micro-step gages, gage block sets, dial indicators, and micrometers are some of the many other intriguing items which make up this display of modern measuring instruments.

Booth 74

THE DOW CHEMICAL CO.

The Dow exhibit will be general in nature showing the various quality con-

trol methods used in producing their diversified line of chemicals and plastics. No products will be displayed.

Booth 80

THE HUGHES AIRCRAFT CO.

The Hughes Aircraft Co. display will graphically depict the vendor reliability program. The suppliers quality system survey, the performance rating system, and the vendor certification program will be illustrated to emphasize Hughes' attempt to solve the quality problems consistent with the procurement of material for advanced complex electronic equipment to high reliability standards. The Hughes Falcon USAF GAR-1D Air-to Air Guided Missile and representative components of the Hughes Armament Control System will be featured.

Booth 82

EDER INSTRUMENT CO.

This display features Eder-Lite miniature inspection lamps and accessories and Eder flexible and rigid inspectroscopes for visual inspection of hidden recesses, deep holes, and other internal features formerly inaccessible.

One of the new products on display will be the Eder "blind hole" inspection telescope.

Booth 84

MILES REPRODUCER CO., INC.

Case histories, lectures, conferences, group therapy, interviews, and dictation may now be recorded at a 60-foot radius with Walkie-Recordall, Briefcase-Conference-Recorder, a lightweight self powered battery-recorder-transcriber. It operates in or out of the closed briefcase; in car, train, plane, while mobile or stationary. The Voice-Activated "Self-Start-Stop" feature automatically starts and stops the recording from microphone or telephone thus eliminating supervision and the recording of silent periods.

See Model CC and Model CCB, Walkie-All-purpose-recorder for indoors and outdoors at Booth 84.

Booth 85

AMERICAN CYSTOSCOPE MAKERS, INC.

American Cystoscope Makers, Inc., extend a cordial invitation to members and guests to visit their exhibit in Booth No. 85. Latest type and design borescopes, optical flats, and miniature lamps will be on display.

Representatives in attendance will welcome the opportunity of discussing any possible uses you may have for these items.

Booth 86

SERVICE DIAMOND TOOL CO.

The Service Diamond Tool Co. will display hardness testing machines and accessories.

Booth 87-88

FEDERAL PRODUCTS CORP.

Federal Products Corp. will display a number of new gages and gaging accessories representing advances in the mechanical-indicating, air, electrical, and electronic methods of gaging. Of special interest to ASQC visitors will be:

1. The new model "Dimensionair" air gage. (Single and multiple units will be set up, together with various types of gaging members for operation by visitors.)
2. Equipment demonstrating recent advances in automatic machine control.
3. The newly developed line of Federal Hardened Gear Dial Indicators.
4. New types of Dial Indicator Gages for Bore, Groove, Shallow Hole, Cam Shaft, and Hole Location measurements.

All equipment will be arranged to permit close inspection and operation by those visiting the Federal booths.

Booth 100

M. E. CUNNINGHAM CO.

The Cunningham Co. will exhibit their regular line of Safety Marking Equipment. Some of the specific items of interest to the quality controller will be Safety Steel Inspector's Stamps, Safety Steel Inspector's Hammers, Utility Marking Outfit, Safety Steel Type Holders, Safety Wedge Grip Letters and Figures, Safety Hevi-Bevl Letters and Figures, Safety Steel Insert Stamps for marking machines, Safety OE Engineer Hammers, GRD-960-2 Marking Fixture, Identification Tags and Badges, Vinyl and Rubber Inspection Stamps, name plates, signs, and other similar articles.

Booth 102

Wilson Mechanical Instrument Division AMERICAN CHAIN & CABLE CO., INC.

The center of attraction at Booth 102 will be the new Console Model, "Rockwell" fully automatic hardness tester. This unit will automatically classify up to 1000 work pieces per hour into three categories—correct, too hard, or too soft. Also on exhibit will be a display of the manufacturer's Manually-Operated Rockwell Hardness Tester, the Rockwell Superficial Hardness Tester, and the Semi-Automatic Rockwell Hardness Tester, Model Y.

Booth 104

THE L. S. STARRETT CO.

The Starrett Co. exhibit will include a complete display of their precision hand measuring tools including their complete new line of dial indicators and dial gages. Also to be shown are many new items recently added with an expanded line of Chrome Plated Rules. Featured will be the entirely new Satin Chrome Plated Vernier Caliper with open face vernier, Starrett Catalog No. 123, and many other new items.

Booth 105

PRATT & WHITNEY CO., INC.

On exhibit at the Pratt & Whitney booth will be an automatic radial play gage, a new design Air-O-Limit gage, an automatic Sigmatic gage, and several items of their standard gaging equipment, including air and electric comparators, and conventional gages. The exhibition of samples of their Cutting Tools and Kellerflex products in lighted showcases is also planned.

Booth 110

CONVAIR-FORT WORTH DIVISION OF GENERAL DYNAMICS CORP.

The Convair exhibit will be primarily devoted to the actual application of quality control techniques at the Fort Worth Division. The theme of the exhibit will be, "The B-58—Quality-Controlled from Conception to Delivery." The exhibit proper highlights the progressive methods employed during the manufacture of the B-58 supersonic bomber, to insure a "top-quality product, on schedule, at the lowest possible cost." Methods for achieving and maintaining a high degree of reliability will also be emphasized.

Booth 111

MARCHANT CALCULATORS, INC.

A display of charts and photographs illustrating the Marchant quality control program, parts boards, and sub-assemblies will be on display at Booth 111. On demonstration stands will be several models of their calculators which will be used to demonstrate figurework required in statistical quality control work, engineering figurework, and other types of calculations of interest to the individual visitors. Copies of booklets will be distributed. The first and only calculator with fully automatic decimals, the Marchant Deci Magic, will also be displayed and demonstrated.

Booth 113

SUNNEN PRODUCTS CO.

The new Sunnen PG-800 Precision Gage, entirely mechanical and with built-in wear compensation, will be on display at the Sunnen Products booth. The complete instrument is portable, requires no connections, and needs no warm-up period. In addition, it has a range from 0.370 to 1.500 inches diameter, a maximum gaging depth of 1¾ inches, a repeat accuracy of ± 0.000005 inches, a linear accuracy over 0.005 inch gage scale ± 0.0000125 inches, and a scale numbered in thousandths of an inch, graduations in 0.000050 inches. This gage is easily and quickly set for any hole size and gives instantaneous reading. Tolerance hands are adjustable to set production limits. Sliding plates and guides regulate desired depth of gaging and allow exploration of holes.

Booth 115

MONROE CALCULATING MACHINE CO., INC.

Workers at all levels of SQC should be interested in a new statistical calculator by Monroe. Termed the "Model 8N-1-213 Statistical" this new QC tool was designed and engineered to handle standard deviations (grouped and ungrouped data), linear and multiple correlation, analysis of variance, and for computing control limits both modified, average, and standard deviation. The machine's capabilities include the following versatile features as standard equipment: automatic squaring of any number, automatic decimals, automatic veeder counter, accumulation, transfer slide, and automatic clearance. Illustrated literature and detailed information will be obtainable at the booth.

Booth 125

THE SHEFFIELD CORP.

Instruments, controls and systems for automatic production, inspection and statistical quality control will be demonstrated at Booth No. 125 by The Sheffield Corp. as well as pneumatic, electronic, and mechanical gages and measuring instruments for use in production, at the bench, and in the toolroom and gage laboratory.

New combinations of pneumatic and electronic gaging circuits and systems for automatic production that feed back signals to warn, adjust or stop the machine if size trend is toward out of tolerance will be demonstrated.

Many types of electronic toolroom and gage laboratory precision inspection instruments such as gage block comparators, height indicators, and internal and external measuring instruments with high-speed, drift-free electronic pick-up and amplification will be in operation.

Visitors to the Sheffield booth will also see new types of adjustable air-tooling for single and multiple Precisionaire® pneumatic inspection instruments.

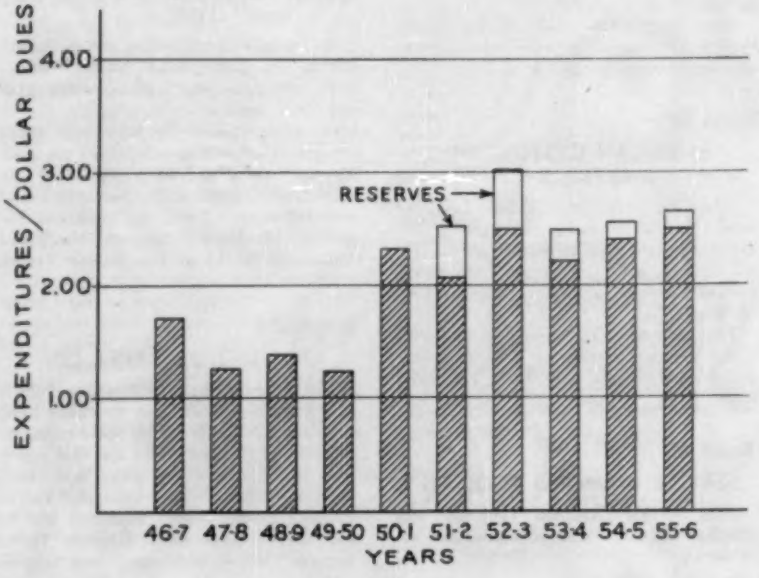
ASQC NEWS

The Member's Dollar—What It Does

IN the February issue of IQC, data and charts were presented to show the distributors of operating income and expense dollars, as well as the changing financial picture over the years with respect to income and expenses on a per-member basis. These data showed increasing publication expenses, and more importantly, a slight excess of operating expense over operating income for each of the past two years.

Further study of the data reveals some additional interesting information, such as the relationship between total Society expenses and member dues, a vital segment of our total income. The chart shown below deficits this relationship for each of the years of the Society's existence. As indicated, in recent years the Society has been able to support activities requiring expenditures of more than 200 percent of the member's dollar. Thus for the 1950-51 year, the Society spent for its operations $2.31 for every $1.00 of dues received. Of course, other Society sponsored activities provided the income required to support these expenditures.

Each year since 1951-52 modest additions have been made to the Society's financial reserve fund, established at that time with the view to providing, ultimately, an adequate reserve as protection against operating contingencies. These additions, expressed in terms of the members dues dollar, are also shown on the chart. It will be noted that the contributions to this fund in the past two years have been quite small. It does not appear that for the 1956-57 year there will be any contribution at all to the fund.



DO YOU HAVE A QUALITY CONTROL PRESENTATION PROBLEM?

QUALITY CONTROL AIDS ARE THE ANSWER

Make your presentation more forceful and understandable by the use of these aids.

QUINCUNX
...This device permits your audience to visualize the creation of a normal distribution pattern as well as the results of variables sampling. All beads are self-contained; nothing to drop out. Done in attractive mahogany complete with zipper carrying case.

ATTRIBUTE SAMPLING DEMONSTRATOR
...Complete unit consists of transparent plastic container, opaque colored beads, and wood paddles permitting easy identification of beads at a distance.

SIMULTATORS
...To demonstrate control chart plotting and shift of distribution pattern.

Lightning Calculator Co.
Box 6192
St. Petersburg Beach 6, Fla.

Growth of IQC

AS shown on the charts in the February issue of *Industrial Quality Control* the expenses for all publications have increased steadily since the founding of the Society. This is perfectly natural as Society growth has increased the demand and the number of publications. To continue this growth pattern, additional income must be provided so that each member may continue to receive more publications, technical papers, additional news and all the other services provided by this fine Society journal.

In reviewing the growth of *Industrial Quality Control*, we only have to go back to 1953 when we published 170 pages of technical material against the approximately 300 pages that will be published in this year's volume—an increase of over 76 percent. This is a tremendously important contribution to scientific literature in these days of increasing need. Unfortunately, with more and more papers being written and presented to cover the field adequately, we must provide additional pages in the coming years to provide a publishing outlet for more significant information in the rapidly growing field of quality control.

In addition to the increase in technical papers *Industrial Quality Control* will have published 100 percent more Society news on members, sections and divisions by the end of this year than it did in 1953.

Much of this increase was made possible by the changeover from a bi-monthly to a monthly journal in 1955. More frequent publication made available additional pages for publication of important technical contributions and up-to-date news.

Additional income is vitally needed to continue improvement and expansion and to add new service departments to *Industrial Quality Control* to further increase its value to every member.

Many plans have been made for the improvement outlined above and as soon as a more favorable balance can be struck between income and expenses, these plans will go forward and make your Journal, *Industrial Quality Control*, the most outstanding scientific publication in any field.

What's New?

ROY A. WYLIE, *Editor*

When inquiring about "What's New?" items, please mention INDUSTRIAL QUALITY CONTROL

A photometric precision instrument, which accomplishes the accurate measurement of extremely thin film thicknesses to the order of molecular dimensions, precise within a few Angstroms, has just been marketed by **Quantum, Inc.**, 756 North Brooksvale Road, Cheshire, Conn. The Quantum Ellipsometer is a polarizing spectrameter than can measure directly the thickness of films which can be deposited on suitable substrates in the range of from several to many hundred Angstroms. In so doing, it fills the gap between molecular layer dimensions and the point where other instrument readings are effective. Use of this instrument is important to fields where very thin films are to be examined such as lubricating agents, surface coatings, adhesives and biological phenomena. With it, new areas of investigation in the biological, chemical and physical sciences are posiible. The instrument is designed for both visual and photometric readings. An ultra-sensitive photomultiplier system is included which provides greater accuracy and reproducibility over visual observation. Literature providing more detailed explanation of the Quantum Ellipsometer, as well as answers to inquiries regarding potential applications, are available by writing to Quantum, Inc.

★ ★ ★

The Wilson Mechanical Instrument Division of **American Chain & Cable Co., Inc.**, Bridgeport 2, Conn. has perfected the Console Model Fully Automatic Hardness Tester, Size 3. The unit will test any metal on the regular Rockwell scales such as A, B, C, D, E, F, G, H and K and will automatically classify tested work pieces in one of three categories, correct, too hard or too soft. The device has controlled hardness limits as close as two Rockwell numbers, is equipped with an automatic counter and has a safety stop for pieces not fed properly. Work pieces may be tested in the unit in either of two

Proceedings of the Eighth Annual Rutgers All-Day Conference

For those of you who were unable to attend this informative conference on quality control, the Society is making available a limited number of copies of the proceedings. The papers presented at the conference covered such varied subjects as:

- Chemical Process Control
- Replicated Sampling
- Statistical Filing Control
- Inventory Control
- Production Adjustment from Sales Trends
- The Span Plan
- Fitting of Response Surfaces
- Basic Concepts of SQC
- Experimental Design
- Design and Analysis of Experiments

Also included in the proceedings are two papers on the Box-Wilson techniques of finding optimum operating conditions. These were presented at the Seventh Annual Rutgers Conference but the demand has been so great for copies that they were incorporated as part of this year's proceedings.

Don't miss this opportunity to add these valuable papers to your library. Remember, the supply is limited. Mail the coupon for your copy today!

ASQC, 161 W. Wisconsin Ave.
Milwaukee 3, Wis.

Send me ..... copies of the "Proceedings of the Eighth Annual Rutgers All-Day Conference" at $2.00 per copy.

Amount ..... Enclosed

Name .....

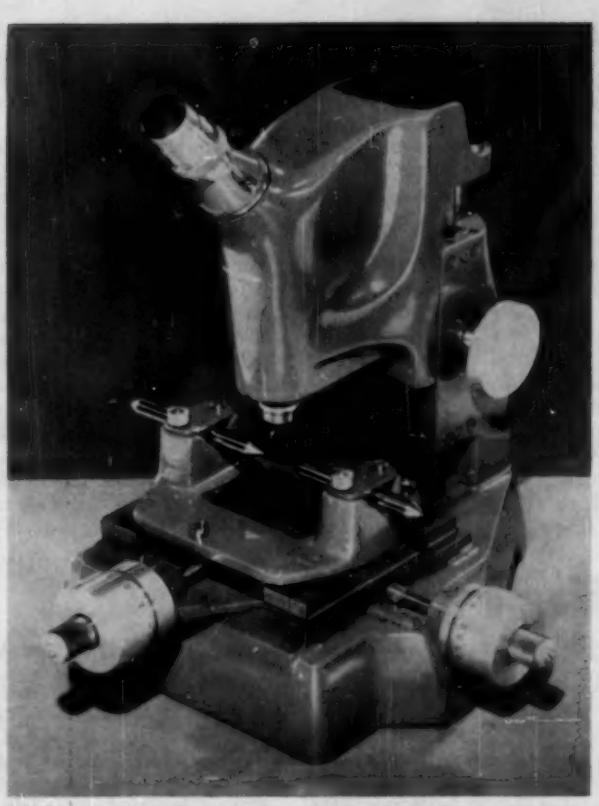
Address .....

.....

ways: manual feed and manual disposal or semi-automatic with manual loading and automatic disposal for classification as to hardness. By making a simple change of plunger extensions, the unit can be set up to test materials of varying thickness from 0.030 to 6 inches. Single tests may be performed by merely snapping a switch which changes the cycle from continuous to single operation.

★ ★ ★

A new microscope for use by inspectors and toolmakers in the inspection and measurement of tools, drill jigs, templates and finished parts has been announced by the **Bausch & Lomb Optical Co.**, Rochester, N. Y. The toolmaker's measuring microscope offers versatility, convenience, sturdiness and accuracy previously unavailable in this price bracket. The major advance is a unique illuminating system. The illumination source is built-in and the beam of light is directed down through the microscope objective, giving true vertical illumination. A collective mirror under the stage plate reflects the light back into the body tube. As a result, both the surface and the contour of parts may be viewed simultaneously. The cross slide stage has a maximum possible range of two inches in the "east-west" direction and one inch in the "north-south" direction. The stage itself rests on ball bearings and its motion is controlled by two micrometer screws. Standard magnification is 35X, but different objective and eyepiece combinations may be used to obtain other magnifications. A protractor eyepiece and centers are available for increasing the versatility of the instrument. Price of the complete basic microscope is $1,200. The protractor eyepiece is $300 and the centers are $120.



Second DoALL Travelling Exhibit The Story of Measurement

Because of a millionth of an inch, modern man is infinitely happier, healthier, and wealthier than his early counterpart, the Stone Age Man.

This thought is forcefully brought out in the second in DoALL's series of travelling exhibits, "The Story of Measurement," which is rapidly becoming one of the most popular programs being scheduled for engineering and technical societies. The series was created to portray the improvement of man's material welfare through the use of tools.

Through the use of cinemascope slides in color and accompanying lecture by C. G. Schelly, noted scientist, inventor, and author, "The Story of Measurement" explains in easy to understand language, "interferometry", the method used to establish the accuracy of our present day standards—gage blocks—and how this accuracy is maintained by regular inspection and calibration in the shop. Mr. Schelly explains the advantages gained by using gage blocks as working gages in the Micro-Step Gaging System; thereby bringing the accuracy of light even closer to the production line.

Sponsor of "The Story of Measurement" exhibit, and responsible for presentation, is The DoALL Company. The exhibit is currently touring the northeastern states. Information regarding further details and bookings of "The Story of Measurement" may be obtained by writing The DoALL Company, Gage Division, 254 North Laurel Avenue, Des Plaines, Ill.

(Ed. note. This exhibit will be part of the DoALL exhibit at the Annual Convention to be held at Detroit in May. See it at Booth No. 70)

★ ★ ★

An improved model of the Dimensionair Air Gage is announced by **Federal Products Corp.**, 1144 Eddy St., Providence 1, R. I. The gage uses the same balanced measuring system as previous Dimensionair gages, but has been improved to minimize the

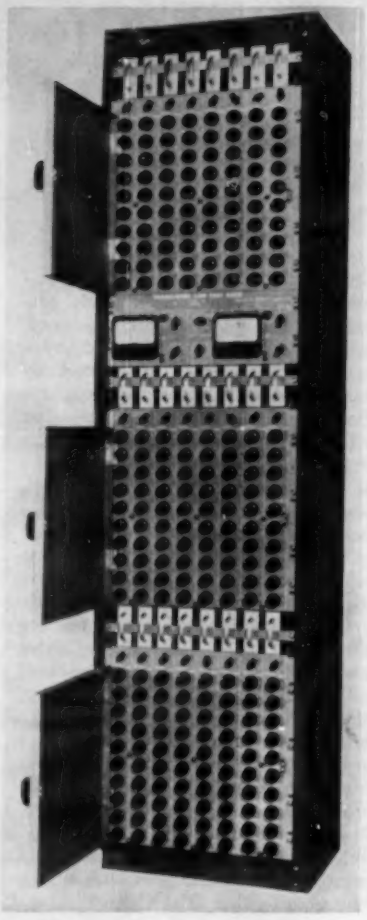
effect of oil and water seeping into the gage from airline. As a further precaution a new and efficient filter is furnished, mounted on the gage itself. The filter has a transparent cup, making it easy to observe the contents and to judge the condition of the airline. A smaller, but more efficient, regulator enables a reduction in the overall size of the Dimensionair. Another improvement in the Dimensionair is a more positive zero adjustment that makes setting the gage to the master more definite and faster. In addition, the new zero adjustment is self-leaning which tends to eliminate contaminants in the zero setting valve. Simplified maintenance is another advantage of the new model. All parts are quickly accessible by removing the six screws that secure the front and the top to the rest of the case.

★ ★ ★

A new compact voltage control unit for testing A.C. operated aircraft equipment and components has been announced by the **OPAD Electric Co.**, 69 Murray St., New York 7, N. Y. The unit operates on 115 volts 400 cycles single phase and provides a continuously adjustable output from zero to 115 volts under a maximum load current of 15 amperes. Standard instrumentation includes a 3½ inch 21 reed ½ percent accurate frequency meter and a 2 percent accurate A.C. voltmeter. Designed to be readily portable, the unit is equipped with a carrying handle, weighs only twelve pounds and is housed in a ventilated enclosure 12 inches wide by 6 inches deep by 7 inches high. A six foot rubber covered input cord is supplied.

★ ★ ★

Consolidated Avionics Corp., 66 Brooklyn Ave., Westbury, Long Island, N. Y., has designed and is manufacturing a series of packed systems for aging and life testing of transistors. Several versions of the equipment are available. The one illustrated permits performance of life tests and application of aging techniques to 240 npn or pnp transistors under controlled operating conditions. Each panel section is divided into eight vertical cells, each having a capacity of ten transistors. Each cell contains ten fixed precision emitter resistors (used in measuring emitter current), ten continuously variable series emitter resistors, and a plug-in unit containing ten precision resistors for providing virtually any desired collector loads for the transistors under test. The ten transistors to be tested in a cell are placed in plug-in cans which are inserted into the equipment and may be bolted in place to prevent unauthorized "borrowing" of transistors being tested. Although the Avionics system permits physical handling of ten transistors at a time, each transistor circuit is isolated from the others, and the performance of each may be evaluated independently. In normal operation, the operator inserts the transistors and sets up desired values of emitter current for each unit using one of the two meters contained on the meter panel. At the same time another meter measures collector voltage. Both meters are provided with zero set, polarity, range, and calibration adjustments and selector



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M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

Cut inspection time in half

with new Gaertner Coordinate Cathetometers

These convenient, reliable optical instruments permit making precise coordinate measurements in a vertical plane. The two dimensions are measured with one setting, object does not have to be rotated. Inspection time is cut in half and resetting errors eliminated.

Versatile Gaertner Coordinate Cathetometers are ideally suited for precision measurements on large objects; also objects or points in recessed, remote, or inaccessible locations. Applications include measuring jet engine sections, complicated castings, printed circuits, bolt holes and bosses on large piece parts, traces on cathode ray tubes, etc.

Because these are optical rather than mechanical measuring instruments, you make non-destructive measurements without contact, distortion, or concern about pressure being applied to the object when making a setting. Instruments available in English or Metric system.

M1236-46— Horizontal range 6", vertical range 4". Reads to 0.0001", working distance 5" to infinity.

M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

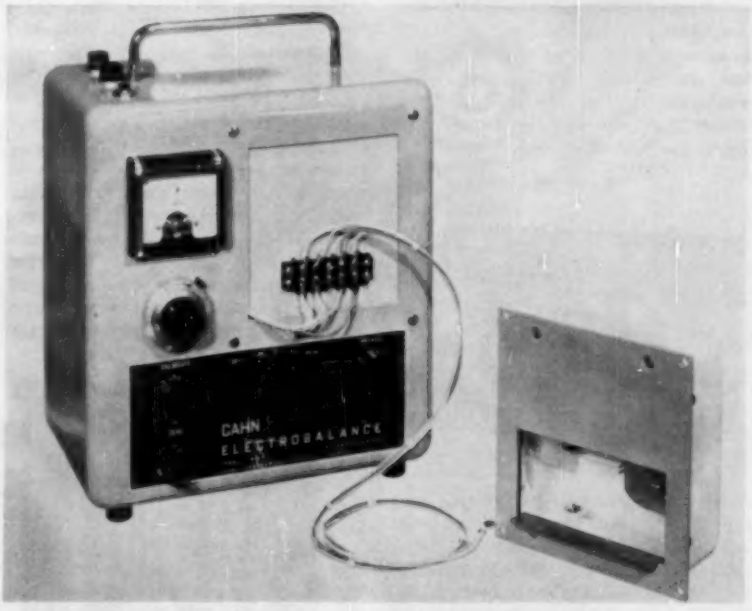
Write for Bulletin 188-53

The Gaertner Scientific Corporation

1243 Wrightwood Ave., Chicago 14, Ill.
Telephone: BUckingham 1-5335

switches for "looking" at pertinent parameters of any transistor under test in this system. All cells may be powered by a single source, or each transistor may be connected to separate source. A table model of the Avionics transistor life test rack is available for processing 80 transistors. All models include numerous convenience and safety features such as snap-lock doors for protecting potentiometer settings, quickly-replaceable load resistance cans, and universal metering facilities.

★ ★ ★



The **Cahn Instrument Co.**, 7712 Danvers St., Downey, Calif., has announced a new type of microbalance. Based on a novel application of physical principles, it is unaffected by shock, vibration and temperature change and can be carried around at will and operated on any bench or desk with ease. Sensitivity and accuracy equal or exceed delicate laboratory microbalances. The sample weight is balanced by torque applied by an electric current in a magnetic field. Because the balance beam is always returned to the same position, torque is exactly proportional to current. Electrical balancing eliminates many delicate mechanical parts and achieves high precision and accuracy. Since sample weight is read directly on a multiturn dial, extreme speed and ease of operation have been found possible. Complete weighings average less than one minute each. Operators unfamiliar with microweighing technique have learned to use the new instrument with a few minutes practice. The Cahn Electrobalance has four ranges of sample weight—0-5 mg with 1 microgram sensitivity, 0-10 mg at 2 microgram sensitivity, 0-20 mg at 5 microgram sensitivity, 0-50 mg at 8 microgran. sensitivity, selected by panel controls. Precision is 0.02 percent and accuracy is 0.5 percent of full scale on all ranges. The entire weighing compartment can be removed from the instrument and located remotely with complete control through four wires from outside. The instrument is smaller than a portable typewriter and weighs less than 12 pounds. It is completely self-contained, requiring no external power or utilities.

★ ★ ★

Mantec, Inc., 126 Maryland St., El Segundo, Calif., have made available

a new automatically controlled 5 cu. ft. multi-environment chamber which can drop working temperature from room level to —65 degrees F. in five minutes and raise to +400 degrees F. in ten minutes. The new model "D-104" maintains pre-selected high or low temperatures during continuous operation at +2 degree F. within a range from —100 degrees F. to +400 degrees F. Its relatively large 100 lb. dry ice capacity should permit completion of most low temperature work without recharging ice. Construction is all steel, including an heliarc welded stainless steel inner chamber completely sealed to prevent seepage of moisture into insulation. For low temperatures a motor driven fan circulates air over dry ice. High temperatures are supplied by an electric heating element which operates within the most economical of three available wattages. Working chamber dimensions are 22½ inches long, 24 inches wide, 15 inches deep. Outside dimensions are 44 inches long, 32 inches wide, 24 inches deep. The dry ice chamber is 14 inches long, 24 inches wide, 15 inches deep. The observation window is 5 inches × 8 inches. There are three instrumentation ports, 2 inches in diameter.

Various types of environment simulation equipment made-to-order for military suppliers to meet special test requirements are also available from Mantec, Inc.

Local Section News

". . . BUT NOT FORGOTTEN"

ALBUQUERQUE A joint meeting of the section and the Albuquerque-Los Alamos IRE on Feb. 12, featured an address by Clifford M. Ryerson, senior reliability administrator, RCA, Camden, N. J. The topic of Mr. Ryerson's talk was "Electronic equipment reliability—control and management."

At the regular meeting on Feb. 18, Clarence R. Burdick, quality control manager of Houdaille Industries, Detroit, spoke to the section on "Quality control as used in manufacturing operations."

ALLENTOWN -BETHLEHEM A plant tour of the General Electric Co. comprised the regular February meeting. The tour pointed up inspection and process control methods and was followed by a coffee and discussion period.

BINGHAMTON The February meeting was a joint meeting with the technical societies of the area. The guest speaker was Frederick J. Schlink, president and technical director of Consumers Research, Inc., Washington, N. J. "Helping the consumer get more for his dollar" was the title of Mr. Schlink's talk.

BOSTON Prof. Ted Brown, who recently retired from the Harvard School of Business Administration, substituted for the scheduled speaker on Feb. 13. Prof. Brown gave a most illuminating talk on "Marketing Research" which proved of great interest to all those present.

Our pre-meeting discussion sessions were continued under the leadership of Bernie Goldsmith, who gave some examples of sign tests for testing runs.

BUZZARDS BAY Welton D. Parker, quality control engineer at the Rockbestos Products Corp. in New Haven, Conn., was main speaker at the Feb. 19 meeting. His subject was "Quality control and assurance by variables." A well attended dinner at the New Bedford Hotel preceded the meeting.

CHARLESTON The Charleston section, officially affiliated with the Society as of Feb. 1, 1957, held its first meeting on Oct. 18, 1956. Leon Bass, vice president of ASQC and manager of quality control of the Jet Engine Division of General Electric, spoke on the aims of the Society and on modern quality control. On Nov. 15 Dr. A. C. Rosander, chief of the sampling and estimating section of the Internal Revenue Service, spoke on the role of sampling in QC. Dr. R. W. Kennard of the engineering service division of DuPont, spoke on elements of linear programming at the Jan. 17 meeting. The application of quality control by the defense department was presented on Feb. 21 by Commander W. C. Logan and Reece Tabor of the inspection department of the U. S. Navy. All of these talks were on the practical applications of SQC techniques.

The education committee is sponsoring a ten week course of instruction on basic quality control. The course is designed to provide a working knowledge of the fundamental techniques of quality control and is based on a series of instructions given to DuPont's technical employees by their QC department. Paul A. Rhudy and J. L. Massau of the quality control department at DuPont's Belle, W. Va., plant are the instructors.

CLEVELAND R. B. Shartle, Standard Register Co., gave a very interesting talk on "Statistics, a tool of management." Mr. Shartle presented a very complete exposition of the methods and techniques used in his company.

COLUMBUS The annual management dinner meeting was held on Feb. 20 at the Deshler-Hilton Hotel. Paul Robert, Gruen Watch Co., Cincinnati, gave a very interesting talk on quality control as a means to new objectives. Mr. Robert also gave us some excellent case histories on work sampling.

We were also honored with the presence of Dr. Max Astrachan, quality control director of USAFI, Wright-Patterson Field, who presented certificates to all who completed the course he taught on acceptance sampling.

CORNING -ELMIRA On Feb. 12, over 75 members and guests of the section and the local chapter of the NACA were honored to hear E. E. Schiesel, Mattatuck Mfg. Co., Waterbury, Conn., speak on "Statistical quality control in cost control." Preceding this meeting, a plant tour of the National Homes Corp., Horseheads, N. Y., was held.

The first meeting of the section's second educational program entitled "Basic quality control" was held Feb. 14 at the Westinghouse Electric Corp. and was attended by more than 35 people. Instructors are S. J. Cherry and E. B. Godsey.

DELAWARE At the Feb. 7 meeting, about 35 members and guests enjoyed a talk by Dr. Robert W. Kennard of du Pont's engineering department on the subject of linear program.

Preceding the dinner a unique application of statistical techniques to the interpretation of taste panel results was presented by L. A. Dirnberger, assistant superintendent at the du Pont plant at Linden, N. J.

GEORGIA The Atlanta group of the section met on Feb. 26 for a talk on "Customer acceptance measurement in the telephone industry" by Harry O. Fewox, general statistician of the Southern Bell Telephone & Telegraph Co., Atlanta.

HAMILTON On the night of Feb. 14 the heaviest snowstorm to hit the area in over 12 years dumped 14 inches of snow on our regular monthly meeting. In spite of this the show went on. A few hardy souls were well rewarded by a most informative talk by P. J. Robinson of Imperial Oil, Toronto. His subject was "A look into operations research."

QUALITY CONTROL ENGINEERS

Our expanding, multi-plant, quality control program now has several permanent openings for outstanding QC Engineers with statistical, mechanical, textile, chemical, or administrative backgrounds. Some positions require travel. All require unusually high standards of technical competence and supervisory or administrative ability. These are complex, important positions of responsibilty and benefits are commensurate with requirements. All applications will be confidential. Submit detailed resume to:

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HARRISBURG In the absence of Bill Masser who was ill, his representative from G. E., D. J. Holmes, presented an interesting talk on "What management expects of the QC engineer." A fine turnout, despite the weather, enjoyed a good meal and a good talk at the Mt. Joy American Legion on Feb. 6.

HUNTSVILLE Carl R. Culverhouse and Mrs. Lillian Keegan of the Redstone Division of Thiokol Chemical Corp., presented a paper prepared by James A. Mitchell of the Tennessee Eastman Corp. entitled "Control of the accuracy of industrial tests and analyses."

KANSAS CITY The February meeting was held at the Blue Hills Restaurant. Following the pre-dinner clinic and the business meeting, G. W. Howard, supervisor of statistical quality control at Convair, Ft. Worth, Texas, presented the subject "An SQC program which speaks the management language—dollars."

LINCOLN The Feb. 8 meeting was held in Omaha. Dr. Frank Dudek, professor at the University of Nebraska, presented "Mathematics can be fun."

A. Pendray presided over a short business meeting prior to Dr. Dudek's address. A specific item of interest to all members of the section was section secretary Dr. Barnard's announcement that membership has increased to 45.

LOS ANGELES The February meeting discussed the subject of operations research and quality control. Dr. Glenn Ghormley gave an excellent paper on the history of *OR*. Dr. Paul Stillson, Shell Development Corp., spoke on "*OR* in *QC* and *QC* in *OR*."

The nominating committee, chaired by Frank Squires of Topp Industries, has made the following nominations for officers for the coming year: chairman—Leo A. Aroian, Hughes Aircraft Co.; vice chairman—Howard C. Todt of Autonetics; treasurer—Halmond Parks, Aerojet-General Corp.

LOUISVILLE Dorsey Dean, supervisory engineer of the development and quality control division of Firestone Tire and Rubber Co., Akron, explained the quality control necessary to keep us rolling safely and swiftly on today's highways in today's powerful cars.

MEMPHIS The February meeting was held on Feb. 26 at the Ford Motor Co. Assembly Plant. Irby C. Key acted as moderator for a panel of speakers from the Ford Motor Co. J. P. Spinosa presented "Ford's organizational structure;" J. O. Bounds —"Association and relation of quality control with other staff departments;" E. D. Johnson—"Quality control as practiced at the assembly plant level." A social hour preceded the program and a business meeting was held after the program with a plant tour following the business meeting.

METROPOLITAN On Feb. 19 an evening meeting was held at the National Cash Register Auditorium in N.Y.C. M. K. Kruger of Bell Laboratories spoke on "Distribution requirement in terms of QC procedures" and Frank Plaff of Esso Standard Oil talked on "Linear programming applications in gasoline blending and other areas" at a pre-meeting clinic. Gerald Sandler of City College dis-

cussed "Quick and dirty methods," a subject which includes many rules of the thumb procedures necessary for on the spot decisions.

The Columbia University Conference, scheduled for Mar. 30, has been postponed until sometime in October.

MILWAUKEE Prof. Frank Kennedy of the Law School of the State University of Iowa gave one of the most stimulating talks we've ever had. Long after the usual ending time, the majority of the crowd was still there to hear more about the "Legal aspects of quality control."

MONTREAL The monthly dinner meeting was held at the Alouette Room, Windsor Station, on Feb. 20. Harold Dodge of the Bell Telephone Laboratories addressed a large audience of members augmented by numerous visitors on the "Skip-lot and chain sampling plans."

NEW HAVEN On Feb. 19 a clinic meeting was held at the North Haven Congregational Church. Following an excellent chicken dinner a short business meeting was held to select a nominating committee for the coming year. Clinic discussions on sampling plans and selling quality control proved to be very interesting.

RACINE Fay Carlson, quality control manager of Warner Electric Brake & Clutch Co., Beloit, Wis., was the guest speaker on Feb. 11. "The inspection function" was the topic presented by Mr. Carlson and was eagerly digested by those attending. This was apparent by the questions asked by the members following the address.

RHODE ISLAND The Feb. 21 meeting featured Charles W. Carter, a consultant for Rath & Strong, Inc. His subject was "Quality engineering and management."

ROCHESTER Rochester's 13th Annual Clinic, held on Feb. 19, was an outstanding success. Over twenty speakers addressed as many groups on subjects from "Basic concepts of quality control" by Prof. Mason E. Wescott to "Analysis of variance for linear and multiple regression" by Dr. R. J. Hader. The luncheon speaker was George A. Peck, vice president, Stromberg-Carlson Div., General Dynamics Corp. The dinner speaker was Gordon Jourdain, manufacturers representative, Oldsmobile Div., GMC. Total clinic attendance exceeded 1200, which gives some idea of the interest in this annual affair. They came from as far away as Texas. We were also pleased to welcome some of our Canadian neighbors.

The clinic general chairman was Thomas J. Soebbing, N. O. Eastman Kodak Co., assisted by a large group of committees who worked long and hard. The section wishes to thank all those who helped make the clinic a success including Ruseell G. McCarthy and Richard Toole, manager and assistant manager, respectively, of Industrial Management Council of Rochester, and their competent staff.

ST. LOUIS The anniversary meeting at which Paul Robert, past president of the Society, spoke was well attended. Mr. Robert, Gruen Watch Co., spoke on "What ASQC can do for the quality control engineer."

SALT LAKE CITY The largest group of the year turned out Feb. 21 to hear Richard H. Meyer of Hughes Aircraft Company deliver his paper on "Time samples measure equipment performance."

SAN BERNARDINO The February meeting was held at the Pomona Country Club. C. F. Horne, manager, Convair Div., General Dynamics Corp., gave an interesting talk on the subject "Reliability."

SAN DIEGO R. H. Turney, chief of quality control, Solar Aircraft, replaced G. S. Barnhardt on the quality audit panel for the Feb. 11 meeting. This meeting was one of the best attended for the entire year with approximately 100 guests.

SEATTLE Dan Frazer of Fred Meyer, Inc., Portland, Ore., presented a very interesting discussion of the problems encountered in applying quality control techniques in the retail merchandising business at the February meeting. The dinner meeting was held at the Exeter Hotel.

SOUTH BEND-MISHAWAKA Prof. Gayle McElrath of the Univ. of Minnesota pleased a ladies night audience with his talk "Quality control, woman's oldest weapon."

SOUTH TEXAS The section and the Texas Manufacturers' Association co-sponsored a very successful all-day conference Feb. 16. There were 189 in attendance.

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STATE UNIVERSITY OF IOWA The section held a two day conference at Davenport on Feb. 14-15 which was attended by 60 members. A plant tour was conducted at the quality control department of Bendix Aviation Corp., Pioneer Central Div., with Stanley Kneipp, chief inspector, and Dick Rode, QC supervisor, conducting the tour.

Further highlights of the conference included a dinner at the BlackHawk Hotel; a panel discussion; "Ultrasonic applications of Quality control" by Dr. Thomas Bulat, director of Ultrasonic Laboratory of Bendix; E. L. Conrade, QC analyst of Deere & Co. spoke on evaluating a QC program.

A short business meeting was held after the conference.

TOLEDO The section held a joint meeting with ASTE, ASME, and AIIE. The meeting was held at the Maumee Yacht Club. Dr. Berrettoni, a consultant for Lamson Sessions and the Cleveland Pneumatic Tube Co., spoke on the "Association of quality control with other divisions of a manufacturing company."

The section participated in engineers' week with one of the main features being the quality control display in a downtown Toledo window. The section was also singularly honored when one of its members, Dr. J. H. Toulouse, chief engineer, quality and specifications department, Owens-Illinois Glass Co., received honorable mention in the engineer of the year award.

WESTERN MASSACHUSETTS The Massachusetts University Extension and the section are co-sponsoring a six-session course in "Operations research." The aim of the course is to familiarize with the basic approach of operations research to decision problems. Registration at the first meeting attained 110 persons.

WINDSOR Feb. 16 was a red letter day for the section when 225 quality conscious persons gathered at the Prince Edward Hotel to attend the all-day QC forum.

May the executive of the section take this medium to express their thanks to all those who assisted in the organization and presentation of their first all-day forum. The response was, indeed, beyond expectation.

WINNEBAGO About 55 members and guests were present at the February meeting. H. J. Jacobson gave an excellent address on "How quality control helps in purchasing."

Dr. Carl Nobel gave an excellent demonstration of operations research at the 5:30 educational session.

". . . CAST THEIR SHADOWS BEFORE"

ALLENTOWN -BETHLEHEM On May 9 a dinner meeting will be held presenting Dr. Ellis Ott of Rutgers University. Dr. Ott's subject will be "How to organize and operate a statistical quality control program."

BOSTON Our final scheduled meeting for the season will be an outing for the entire family on Saturday, May 18, at Cherry Hill Farm in Danvers, Mass. Don't expect much formal quality control, but there will be ample hamburgers, hot dogs, etc. This is your chance to let your wife find out that quality controllers are human, too! (Last year was a sellout!)

BUZZARDS BAY Richard A. Cotter of the Speidel Corp. in Providence, R. I., will be the main speaker at the May 14 meeting to be held at the Continental Screw Co., New Bedford. His topic will be "Putting frequency distributions to work in industry."

CHICAGO May 3 is the important date for members of the section to bring their best pal to an informal evening of dining and dancing at the Log Cabin Inn, 5064 Archer Ave. This is the gala social event of the season and the program committee will make every conceivable preparation to be statistically certain of a successful affair.

Uses of IBM equipment for processing statistical quality control data will be explained by IBM representative Larry G. Brown at the May 14 meeting of the Calumet Sub-group. The dinner meeting, starting at 6:30 p.m., will be held at the San Remo Restaurant, 3904 Ridge Road (Route 6), in Highland, Ind.

CLEVELAND A special combined meeting is planned for May 3, when Ellis R. Ott of Rutgers University will be speaking on "Trouble shooting with control charts" while at the same time members' wives will be entertained by Mrs. Ott who will give an illustrated lecture on India. We are expecting a large turn-out for our "Ladies' night" meeting.

COLUMBUS Our social night this year will be held on Apr. 27 at the Colony Restaurant at 6:30 p.m. Members and their wives or girl friends and guests are invited. Contact any section officer for particulars. Mrs. Gloria Strong, selection interviewer for Ohio Bell Telephone, will talk on "Men on my line."

CORNING -ELMIRA The last formal meeting of the year will be held on May 14 with a management night program. The guest speaker for the evening will be Dorian Shainin, industrial consultant, Rath & Strong, Inc., who will speak on "Breaking through industrial problem barriers." The meeting will be held in Elmira at the Langwell Hotel.

DELAWARE On May 2 a comparatively new application for statistical techniques will be presented by J. J. Meyer, senior supervisor in the kinetics chemicals area of du Pont's Chambers Works. Joe's subject is "Statistical safety control" and covers the procedures used at Chambers Works (operations involving some 6000 people) consisting of a statistical sampling plan to appraise the safety level of an operation by a randomly timed safety inspection of a randomly selected area, the inspection including both equipment and people.

EVANSVILLE -OWENSBORO If all goes well and our plans bear fruit, the section will have a chartered bus which will take us to the Auto-Lite Plant in Vincennes, Ind. A tour of the Auto-Lite Plant will be extremely informative and of interest to all, and the bus trip will probably make the entire evening a gala affair.

GEORGIA The Atlanta group will meet on Tuesday, Apr. 30, at 7:45 p.m. in Room 1127, Hurt Building, for a talk on "Some comments on the application of statistical methods in connection with

accounting" by Dr. John H. MacKay, associate professor of industrial engineering, Georgia Institute of Technology, Atlanta.

HAMILTON The May 9 meeting will be held in Canadian Westinghouse Auditorium. The speaker will be Dr. J. B. Pringle of the Bell Telephone Co., Montreal. His topic will be "Where, why, when, and how to install a quality control program."

HARRISBURG On Wednesday, May 1, Wm. Buhl will speak to the section on "Administrative applications of QC." The meeting will be held at the Harrisburg Legion.

KANSAS CITY The section will hold its spring social meeting on May 8. As a part of this meeting, the section will elect its officers for 1957-58.

LOS ANGELES The April meeting will discuss the "Effect of component failure patterns on systems reliability." The speaker will be Ralph E. Kuehn, manager of reliability engineering, Airborne Computer Laboratories, IBM Corp., Vestal, N. Y.

The May meeting will discuss "Planning for management." Speakers will be Ray S. Thomas, director of administrative systems, and Robert W. Young, director of QC, both of Radioplane Co. Dr. Harry G. Romig, director of quality methods and reliability at Summers Gyroscope Co., will be the moderator.

LOUISVILLE Louisville is unique in that we have an organization of representatives from twenty-five scientific and technical societies functioning as the Louisville Engineering and Scientific Council. This council unifies and co-ordinates the efforts of the various societies to bring about a better understanding of each profession. The 1956-57 president is our own member, Marion Cline, of J. E. Seagram and Co. The annual council banquet will be held on May 16.

MILWAUKEE The annual business and social meeting to be held on May 13 is our time for the annual report, the installation of officers, and a wonderful good ol' Milwaukee style social meeting. Jerry Jaske, Allis-Chalmers Co., is in charge of arrangements.

MONTREAL On May 15 the section will hold its monthly meeting at the Mechanics Institute. Miss Bonnie Small of the Western Electric Co. will be the guest speaker.

NEW HAVEN A clinic meeting will be held on Apr. 23 at the Hamden Plains Methodist Church. Dinner will be served at 6:30 pm. The topics for discussion will be "Design of experiments" and "Problems in quality control management."

RHODE ISLAND A dinner dance will be held Apr. 27 for the annual ladies night.

ST. LOUIS "Computers as applied to statistical calculations" will be the topic for the Apr. 26 meeting. It will be given by Norman R. Moss, applied science representative, IBM Corp., Pittsburgh, Pa.

SAN BERNARDINO The May 9 meeting will be held at the Pomona Country Club. This will be a joint meeting with the American Society of Industrial Engineers, featuring a panel discussion. The panel subject will be work sampling and ratio delay. The panel members are; Dr. Edward Coleman and Dr. Ralph M. Barnes of the University of California at Los Angeles, and Robert Edgecombe, Virtue Mfg. Co., Los Angeles.

SAN DIEGO The May 13 meeting will deal with a very timely subject, "Brazed honeycomb." This will be a dinner meeting at the North Park Club.

SEATTLE "The legal aspects of quality control" will be discussed at the May 14 meeting. Brad Jones, a partner in the law firm of Howe, Davis, Riese, and Jones, will be the speaker on this very timely subject.

SOUTH BEND -MISHAWAKA The April meeting will feature two parts; announcement of new officers and a talk by one of the leading statisticians of our field. Dr. W. R. Pabst will present "Quality control for the Navy."

SOUTH TEXAS Ben Levin of the Navy inspection office will be the speaker at the May 7 meeting. Mr. Levin's topic will be the "Use of MIL-STD-105A in Naval inspection." This will be a dinner meeting with time and place to be announced later.

WESTERN MASSACHUSETTS On Tuesday, May 14, at the Sheraton-Kimball Hotel, 8 p.m., G. J. Leahy of Sears-Roebuck & Co., will talk on "Statistical quality control in clerical work."

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"The Name that Counts"

WINDSOR The May meeting has been cancelled in favor of the Society's Annual Convention being held in Detroit.

WINNEBAGO John B. Cobb, Standard Oil Co., will address the May 13 meeting to be held at the Appleton Elks Club. A training session and educational session will be conducted by Dr. Carl Noble on operations research. A problem in linear programming will also be discussed.

"AS YE SOW . . ."

UNIVERSITY OF OKLAHOMA A repeat of the successful short course in "Industrial statistics for the process industries" will be held July 8-19 at the University of Oklahoma under the supervision of the School of Chemical Engineering.

This course is directed specifically towards the needs of engineers and other technical people working in the process industries. Emphasis is placed on the practical applications of the various advanced statistical techniques successfully used in process control, production improvement, and experimental design. The basic concepts will be discussed and the advanced techniques will include sampling, regression and correlation analyses, experimental designs, and analyses of data.

This course is jointly sponsored by the Extension Division of the University of Oklahoma and the Chemical Division of ASQC. Attendance is limited to 40 people.

For further information, inquiries should be directed to Dr. R. L. Huntington, School of Chemical Engineering, University of Oklahoma, Norman, Okla.

CHICAGO On Apr. 23 the entire membership of the section's basic educational program committee will be on hand to answer questions presented by program participants. Before the question session, Bill Lieberman will discuss the challenging problems of "Administration and organization of a quality control program." The place—Room 785 (Sinha Hall), Roosevelt University, 430 S. Michigan Ave. The time—7:30 pm.

CLEVELAND November 5, 1957, has been chosen for the big day. The Fourth Annual Cleveland Conference, under the chairmanship of Charles Joseph, will be held at the Carter Hotel on that day. More information on this event will be announced through the local section and *Industrial Quality Control*.

MILWAUKEE The evaluation session of the intermediate QC educational series will be held on May 13, one hour prior to the business meeting. This will give all concerned an opportunity to offer suggestions for the improvement of the series.

NORTHEASTERN INDIANA The tenth annual conference of the Northeastern Indiana section will be held May 2 at the Chamber of Commerce, Fort Wayne, with registration beginning promptly at 12 noon.

Immediately after registration, a plant tour of the facilities of Dana Corp., one of Fort Wayne's larger industries, will be conducted. Upon return to the Chamber of Commerce, the assemblage will hear a number of well-known speakers on subjects of interest to the inspector, the quality control engineer, and to higher management.

NORTH CAROLINA STATE COLLEGE The Institute of Statistics at North Carolina State College will sponsor a one-week intensive short course in statistics methods for research workers in industry and the physical sciences beginning the week of June 3. The course will be held at Brevard college in Brevard, N. C.

The course will be run in two sections—an elementary and an advanced.

A registration fee of $100 will be charged. Enrollment will be limited to 50 students in each section.

For further information, write: The Institute of Statistics, North Carolina State College, Box 5457, Raleigh, N. C.

INTRODUCTORY QC SHORT COURSE Marquette University, in cooperation with the Milwaukee section of the Society, is offering a two-week short course entitled "Introduction to quality control by statistical methods" to be held June 10-21.

The program is designed for those in industry who desire a basic course in SQC and also for those who wish to apply the techniques to other managerial problem areas. Enrollees will be offered an opportunity to familiarize themselves with fundamentals, examine sample problems, become acquainted with the latest thinking and techniques in the field, broaden their concept of the use of statistical methods, and discuss common problems.

The staff for this course comprises Professor Gayle McElrath of the University of Minnesota and Harmon Bayer, quality control consultant, Detroit, Mich. They will be assisted by numerous guest speakers from industry.

Topics included in the course are basic techniques, basic charts, sampling, applying, and controlling.

The course fee will be $180.00 which includes all materials and ten lunches. Registration or further information may be obtained from Dr. Russell L. Moberly, Director, Management Center, College of Business Administration, Marquette University, Milwaukee 3, Wis.

IQC ADVERTISERS INDEX

—APRIL 1957—

All American Tool & Mfg. Co. 37
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Richard Thorndike Agency

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Gray & Rodgers

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Lightning Calculator Co. 26

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Whipple & Black Advertising Company

Veeder-Root, Inc. 35
Sutherland-Abbott

SOUTH BEND -MISHAWAKA Plans are now being made for a one-day conference during the next season. Wayne Miller has been appointed conference chairman. This program will be a proving ground for the section prior to bidding for a Midwest Conference.

PURDUE UNIVERSITY ADVANCED COURSE JUNE 11-21 The eleventh annual advanced course in "Quality control by statistical methods" will be held at Purdue University, Lafayette, Ind., June 11-21. The course is planned for those who have already had an elementary course and wish to go on to more advanced techniques.

The subject matter includes significance tests and estimation, acceptance sampling by variables, sequential analysis, linear and multiple correlation, and a thorough grounding in analysis of variance. There are 23 hour-sessions on the last subject and related topics. The course is under the direction of Professor Irving W. Burr of Purdue. It is expected that other instructors in the course will include Professors Cecil C. Craig of University of Michigan, Charles R. Hicks of Purdue, Lloyd A. Knowler of University of Iowa, Edwin G. Olds of Carnegie Institute of Technology, and Mason E. Wescott of Rutgers University.

Further information may be obtained from Professor Burr at Purdue University, Lafayette, Indiana.

THE AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS The American Institute of Industrial Engineers will hold its 8th Annual Conference in New York City at the Hotel Statler on May 16-17. The Conference is open to anyone interested in management or industrial engineering.

More than 20 speakers will talk on a wide variety of industrial engineering topics. Of particular interest to quality control people will be J. M. Juran speaking on "The industrial engineer and quality control," Allen R. Crawford on "Applying statistics to industrial engineering," O. A. Hoffman on "A progress report on operations research," P. A. Toll on "How to make a computer feasibility study," and D. G. Malcolm on "Inventory control by operations research." Other papers will cover such areas as work simplification, time study, production scheduling, organization, etc. The banquet speech topic will be "The earth satellite project" delivered by N. E. Felt, Jr., operations manager of the Glenn L. Martin Co. Small group seminars will be conducted to provide the opportunity for detailed discussion of some of the papers.

For a complete program, send a postcard with the word "Program" to American Institute of Industrial Engineers, Inc., P. O. Box 8, Substation 135, New York 53, N. Y.

STATE UNIVERSITY OF IOWA The College of Engineering, State University of Iowa, announces the eighteenth management course to be held June 10-22 in Iowa City.

The entire program is designed for those who have need to use management techniques—factory managers, foremen, industrial engineers, methods and time study analysts, cost men, office executives, and others in related work. To the intensive course of instruction is added a series of talks by recognized authorities on new developments, applications, and problems.

The regular State University of Iowa teaching staff will be augmented by outstanding men from a variety of industries and other educational institutions.

Communications concerning the course should be sent to J. Wayne Deegan, 122 Engineering Building, State University of Iowa, Iowa City, Iowa.

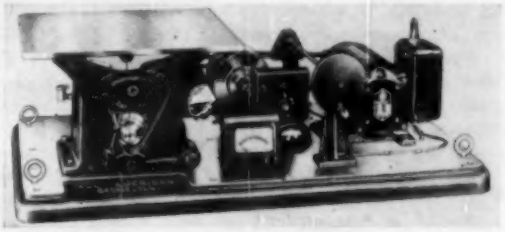
"FOR MANY ARE CALLED, BUT FEW ARE . . ."

CHARLESTON The ink was hardly dry on the notice of the election of the officers of the section when we lost our treasurer, K. W. Filbert. Ken was one of the prime movers in organizing the local section and was awarded by being elected treasurer. However, he has been transferred to du Pont's polychemicals division at Wilmington, Dela., and resigned as our treasurer. The executive committee appointed H. C. Morton of Carbon Fuel to fill the unexpired term.

DELAWARE Loren J. "Larry" Steinhaurer has been selected treasurer of the section to fill the unexpired term of Le Roy W. "Bud" Miller who has been promoted by his company and transferred to Newman, Ga.

EVANSVILLE -OWENSBORO At the Feb. 19 meeting Harvey S. Bower was elected by the executive committee to the office of vice chairman to replace Charles Singer who had resigned due to a change in position which required him to move to Arizona. Mr. Bower has been a member of this section for some time, and we know that he will do an excellent job as our new vice chairman.

New, All American Model 150 VA-D Vibration Fatigue Test Machine Handles Large Assemblies Or Parts, Up To 150 Lbs.



This new addition to the All American line of vibration fatigue test machines produces vibration vertically in simple harmonic motion. Parts or equipment, up to 150 lbs. in weight are subjected to thorough, accurate vibration fatigue test. Machine has a 50% overload factor. Sturdy anti-friction mechanism. Load on table is carried on sturdy "V" frames. Range selector (automatic frequency control) changes acceleration automatically from 10 to 60 cycles per second and back, or any choice of cycles within that range. After finding critical vibration point, frequencies can be held there to determine final breakdown of part being tested.

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It is with deep regret that the Syracuse section reports the sudden and untimely passing of its treasurer, Mr. Gerald N. Gaynor, on January 19, 1957. Jerry was an ardent and enthusiastic officer and his inspiring personality will be greatly missed.

WINNEBAGO John C. Nelson, Fox River Paper Co., was appointed vice chairman to fill the unexpired term of Willard Carlson, Whiting-Plover, who has taken residence in upper New York state.

DIVISIONS

Chemical Division

The First Annual Technical Conference of the Division will be held on Oct. 18, 1957, at the Benjamin Franklin Hotel, Philadelphia, Pa. General chairman of this first annual technical conference is William Chelgren, engineering department, E. I. du Pont de Nemours Co., Wilmington, Dela.

Administrative Applications Division

The Administrative Applications Division, with the assistance of The Chicago Association of Commerce and Industry, held its first annual conference at the Hotel Congress in Chicago on Feb. 8-9. With some trepidation, plans had been made for an attendance of 250. A great deal of commendation is due the hotel and the local committee for their splendid handling of the nearly 400 who registered. The very large attendance is directly attributable to three factors: (1) The increasing concern of business and industry for making use of the techniques of statistical quality control for quality improvement and assurance in clerical and accounting problems, industrial engineering and management decisions; (2) The creditable efforts of the program committee; and (3) The extensive advertising of the conference. Six papers were presented in each of the three major areas of Division interest. In addition, Mr. A. F. Jacobson, President of Northwestern Bell Telephone Company, spoke at Friday's luncheon on "Establishing comparable performance indexes for different departments of our telephone companies." Also at the luncheon, ASQC President Dale Lobsinger, who might be considered the father of the Division, and who is certainly one of its most ardent devotees, stated the case for Society and Division membership very effectively, for the benefit of the large number of non-members present.

Inspired by the enthusiastic attendance at its first conference, and reassured by the resultant money in the bank, the Division's Council is already laying the ground work for its second conference.

Leon Gilford of the U. S. Bureau of the Census is shown addressing the first annual conference of the Administrative Applications Division on the subject of "Statistical Control of Clerical Operations."

Marion Elmer "Jerry" King

THE Society suffered a real loss on February 24, 1957 with the passing of M. E. "Jerry" King, Chief Engineer of the Quality Control Division of the Bureau of Ordnance. He had apparently regained his full strength and capability after a brain hemorrhage last year. At the time of his death he was getting ready to fly to a reliability meeting at the Red Stone Arsenal. He was 53 years old.

Marion E. King obtained his degree in Electrical Engineering from North Carolina State College in 1923. At the outset of his career Mr. King entered the communications field, working successively with Western Electric Company, Victor Talking Machine Company, Bell Telephone Laboratories, and the Philco Radio and Television Corporation.

From March 1941 to June 1946 Mr. King served in the Army Signal Corps at Fort Monmouth, New Jersey, and as Chief, Unit Training Branch, Personnel and Training Division, Office Chief Signal Officer, Washington, D. C. He attained the rank of Lieutenant Colonel, Signal Corps. Colonel King was awarded the Legion of Merit for performance of duty.

In June 1946 Mr. King became Assistant Chief, VT Fuze Division, Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland. In October 1946 he transferred to the Quality Control Division, Bureau of Ordnance where he served as Branch Head of the Fire Control, Underwater Ordnance and Guided Missile Branch until July 1950. From July 1950 until his death Mr. King was the Division Engineer, Quality Control Division, Bureau of Ordnance.

Jerry King was a Fellow of ASQC, a member of the Electronics Technical Committee of the Electronics Division, a member of the Committee on International Cooperation and of the Professional Relations Committee. He was formerly chairman of the Washington section of ASQC. He was also a senior member of the Institute of Radio Engineers, a member of the IRE Committee on Reliability and Quality Control, and Treasurer of the 2nd and 3rd Symposium on Reliability and Quality Control.

Jerry was well known to many members of the Society through his talks and presentations to annual conventions and local sections. His subjects covered Vendor Certification, the Application of Military Sampling Plans, the celebrated CIGAIP (Coordinated Industry Government Acceptance Inspection Plan) which he pioneered and fostered, and the BUORD Procedure for Evaluations of a Contractor's Inspection System, which he developed. His work will long be remembered by those doing business with the Navy and by those interested in these fields of Quality Control.

Mr. King was interred in Arlington National Cemetery, and is survived by his wife Peggy (Lawrence) King, and his parents M. H. and Ada (Robertson) King.

Bibliography

JOSEPH MOVSHIN, *Editor*

Assisted by the Editorial Committee, St. Louis Section, ASQC

9220 Old Bonhomme Road, St. Louis 24, Mo.

BIBLIOGRAPHICAL

QUALITY CONTROL IN ELECTRONICS, by M. N. Torrey
(Institute of Radio Engineers—Proceedings, v. 44, n. 11, Nov., 1956, p. 1521-30)

This article reviews some of the literature on quality control including articles, pamphlets and books. Published examples of the use of quality control and statistical methods in electronics are included as well as general descriptive material on quality control and statistics. Bibliography includes 65 references.

APPLICATION—ELECTRICAL INDUSTRY

NEW LIFE—QUALITY MEASURE FOR ELECTRON TUBES, by J. H. K. Kao
(Institute of Radio Engineers—Transactions on Reliability and Quality Control PGRQC-7, Apr. 1956, p. 1-11)

A new measurement for life quality of electron tubes is proposed by the author. This incorporates information based on tube failure age distribution. It is suggested that this distribution approach replace the "average life percentage" specified in JAN-1A specifications.

RACER — PROPOSED RATING SYSTEM FOR ELECTRONIC COMPONENTS AND DEVICES, by J. J. Lamb
(Institute of Radio Engineers—Transactions on Reliability and Quality Control PGRQC-6, Feb., 1956, p. 1-10)

Five basic criteria are suggested as a means of comprehending all pertinent attributes of any device to be selected. These are: reliability, availability, compatibility, economy, and reproducibility. These are described and defined by the author along with a numerical system for evaluating the proposed "RACER" plan.

APPLICATION—TEXTILE INDUSTRY

TESTS FOR BETTER YARN PRODUCTION, by Norbert L. Enrick
(Modern Textile Magazine, Jan., 1957, p. 37-42)

Continuing the series, this seventh article again describes test procedures, equipment, records, and analysis for the following tests: (1) Control of Package Sizes, Roving through Yarn; (2) Production and Quality Speeds of Machinery; (3) Moisture in Textile Materials; (4) Mill Humidification; (5) Evenness Testing of Sliver, Roving and Yarn. Tables of data and corresponding test results are used as illustrations. Samples sizes and frequency of check are included.

YARN PREPARATION TESTS FOR BETTER WEAVING, by Norbert L. Enrick
(Modern Textiles Magazine, Feb., 1957, p. 39-40)

The eighth article in the series of Mill Test Procedures considers quality of purchased yarn rather than manufacturing control. Again detailed test procedures are provided for the following: (1) Purchased Yarn Quality test; (2) Filament Yarn Dye Index test; (3) Winder Tensions Check; (4) Winder Slub Catcher Settings; (5) Twist Setting Test; (6) Ply Twist Determination; (7) Quilling Frame Check. Sample procedures, records, and evaluations are included.

APPLICATION—METAL WORKING

HOW TO PREDICT MACHINE CAPABILITY, by William H. Nahm, Quality Control Engineer, Brush Electronics Company, Cleveland, Ohio
(The Tool Engineer, v. 38, n. 1, Jan., 1957, p. 87)

This article tells how to establish a machine's tolerance by applying control limits to an $\bar{X}$ and R chart. By keeping these records of various jobs run, a Tool Engineer may assign close tolerance jobs to a capable machine thus reducing scrap.

Selected references in the Bibliography of *Industrial Quality Control* are obtained from the following sources:

The International Statistical Institute, *International Journal of Abstracts on Statistical Methods in Industry.*

ENGINEERING & EXPERIMENTS

WRITING "SPECS": QUESTIONS THAT STATISTICS CAN ANSWER, by Dorian Shainin, Rath & Strong, Inc., Industrial Consultants
(Materials & Methods, v. 45, n. 2, Feb., 1957, p. 109)

By using the techniques of statistical quality control, the engineer will have many facts which will enable him to write better material specifications. The article answers three questions which statistics will help spec. engineers answer: (1) Which variable must be controlled? (2) How closely can it be controlled? (3) How much does it actually affect the end product?

MANAGEMENT & PERSONNEL, GENERAL

OBSERVATIONS ON QUALITY ASSURANCE AND RELIABILITY, by E. G. D. Paterson, Dir. of Quality Assurance, Bell Telephone Laboratories, Inc.
(Tooling & Production, v. XXII, n. 12, Mar., 1957, p. 12)

Reliability is defined as an important attribute of quality. The importance of reliability and quality assurance from management's point of view is discussed. The dependence of reliability upon the production organization and its use of quality control and corrective measures is pointed out. The importance of accumulated knowledge to predict reliability is stressed. This is increasingly true as products become more complicated and reliability becomes more important to both manufacturing and the customer. The role of automation as a production tool rather than as a panacea for reliability is noted.

STOP REJECTS WITH PROCESS CONTROL, by E. C. Ploetz, Supervisor Process Control, Kankakee Works, A. O. Smith Corp.
(Mill & Factory, v. 60, n. 3, Mar., 1957, p. 88-91)

Process control is presented as an important supplement to inspection and "normal" quality control operations. Process control in-

cludes the following: (1) Determine quality levels, (2) Study defects, (3) Set up time schedules, (4) Remedy process deviations, (5) Review control points, (6) Troubleshoot unscheduled manufacturing problems, (7) Develop new processes, (8) Write Process Controls. The execution of these functions at A. O. Smith Corp., Kankakee Plant is described.

INDUSTRIAL MANAGEMENT

SHARPEN DECISION-MAKING WITH LINEAR PROGRAMMING
(Mill & Factory, v. 60, n. 2, Feb., 1957, p. 112-114)

Linear Programming is described as a "mathematical technique for choosing the best way to do something when many ways exist". In this particular article, scheduling of work through a series of operations through several drill presses is indicated. The matrix is given for the particular illustrations and the handling together with the effect of a trial and error method. The advantages of linear programming are outlined.

MISCELLANEOUS

EDITORIAL: I + SQC + MC + R = PERFECTION, by E. Willard Pennington, Editor, Tooling & Production
(Tooling & Production, v. XXII, n. 12, Mar., 1957, p. 73)

This brief editorial points up the fact that inspection, statistical quality control, machine capability, and reliability must all be considered as vital factors in the achievement of industrial quality perfection.

SCIENTIFIC METHOD, STATISTICAL INFERENCE, AND THE LAW, by Gayle W. McElrath, Industrial Engineering Division, and Jacob E. Bearman, Biostatistics Division, (University of Minnesota)
(Science, v. 124, n. 3222, Sept. 28, 1956, p. 589-590)

This is a letter addressed to Science Magazine. It does present the statistical concept of certainty and probability as applied to investigations of physical phenomenon. This is contrasted with some legal concepts contained in such words as "reasonable" "with certainty" and "beyond a doubt". Decision making from a statistical or scientific as well as legal viewpoint is also discussed.

INSPECTION MACHINE SORTS FITS AND SIZES
(Metalworking, v. XIII, n. 2, Feb., 1957, p. 3-5)

An automatic inspection machine for aircraft cable connectors is described in this article. Pin sockets are fitted automatically to a station where they are gaged. They are then moved on a wheel where "memory" mechanism rejects and removes defective sockets. Series of solenoid switches actuates the mechanism.

POSITIONS AVAILABLE

Address all replies to box number references to: American Society for Quality Control, Room 6197 Plankinton Bldg., 161 W. Wisconsin Ave., Milwaukee, Wis.

STATISTICAL QUALITY CONTROL ENGINEER

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QUALITY REPORTING

START QUALITY CONTROL AT THE SOURCE, by F. C. Jacquemard, Project Manager, Purchase Quality Control, International Business Machines Corp.
(Mill & Factory, v. 60, n. 2, Feb., 1957, p. 104)

IBM outlines a program that helps a vendor understand just what kind and quality of material is expected. The article also shows a way to compute a vendor's quality rating.

CONSULTING SERVICES

Responsibility of the American Society for Quality Control, Inc., for Consulting Services advertising is limited to certification that advertisers hold the grade of membership in the Society stated in their advertisements. Qualification requirements for the several grades of membership are set forth in the Constitution of the Society.

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Fuggiti: This is the Exide-Ironclad positive plate. And in any battery, power reserve is governed by positive plate area.

Reporter: Then do you mean that Exide-Ironclad Batteries have *more* positive plate area?

Fuggiti: Exactly. You can see that here. The cylindrical power tubes are arranged in a row. So the semicircular sides give an effective plate area one-third more than the plate size.

Reporter: How does that increase power reserve?

Fuggiti: Because there's a bigger working surface of battery plate exposed to the electrolyte. Power response is faster.

Reporter: What does this mean in battery performance?

Fuggiti: It means the battery can provide power to spare for peak power loads as well as a dependable source for continuous loads.

Reporter: Obviously this is an important feature of the Exide-Ironclad Batteries.

Fuggiti: Yes it is, but it's just one of many engineering details that contribute to their long life and high capacity.

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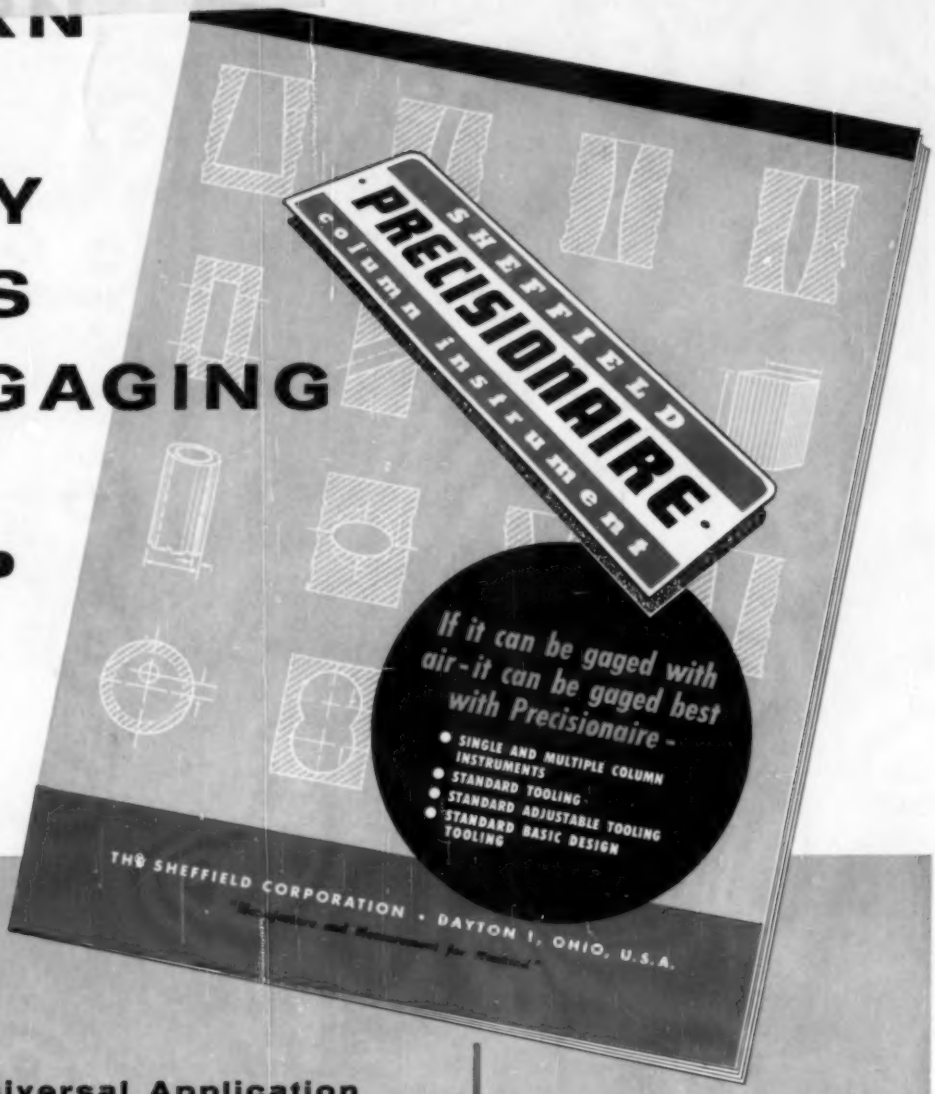
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